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- Please read carefully and observe the instructions given in this documentation. Thus you avoid accidents, preserve the manufacturer's warranty and ensure that your engine always functions properly and reliably.
- This engine is constructed solely for the use - as defined by the equipment manufacturer (intended use) - designated in the scope of supply. Any use beyond this is contrary to the intended purpose. The manufacturer is not responsible for any damage incurred on this account. That risk is borne solely by the user.
- Intended use also includes compliance with the operating, maintenance and repair instructions issued by the manufacturer. The engine may only be used, maintained and repaired by those who are familiar with it and have received instruction about the hazards.
- Make sure that this documentation is readily available for all those carrying out operating, maintenance and repair work and that the contents are well understood.
- Non-compliance with this documentation may result in malfunction and engine damage as well as personal injuries for which the manufacturer shall not accept any liability.
- A prerequisite for successful maintenance and repair work is that all required equipment, hand and special tools are available and in perfect working order.
- Engine components such as springs, clamps, snap rings, etc. may cause injury if not handled with care.
- Accident prevention regulations and all other generally recognized regulations on safety and occupational medicine are to be observed.
- Optimal operation economy, reliability and durability of the engine can only be ensured when genuine parts of DEUTZ AG are used.
- Engine repairs must be carried out in accordance with intended use. For conversions, only parts approved by DEUTZ AG for a specific purpose should be used. Unauthorised changes made to the engine invalidate all liability on the part of the manufacturer for damage incurred as a result. Non-compliance with this rule nullifies the warranty!

## 1

DEUTZ engines have been developed for a broad range of applications. The extensive range of models available ensures that each particular requirement can be fulfilled.

The engine is equipped for the specific installation conditions, that means that not all parts and components described in this documentation are actually built onto your engine.

We have tried to point out these differences so that can easily find the operating, maintenance and repair specifications relevant to your engine.

Should you have any further questions, please do not hesitate to contact us.

Yours

DEUTZ AG

**DEUTZ Engines**

are the product of many years research and development work. Our broad-based expertise acquired over the years, together with stringent quality requirements, ensures that the engines we produce have a long service life, and are very reliable and economic in fuel consumption. It goes without saying that they also fulfil the high requirements placed on environmental protection.

**Servicing and maintenance work**

is a major factor in ensuring that the engine performs in the way intended. It is therefore essential that the stipulated maintenance schedules are observed and that maintenance and servicing work is performed carefully. Particular attention needs to be paid to this in demanding operating environments beyond normal working conditions.

**DEUTZ AG**

In case of operating defects or inquiries for spare parts, please get in touch with one of our representative service centres. Our trained personnel are able to repair any damage incurred promptly and professionally using original parts.

Original parts made by DEUTZ AG are always state-of-the-art.

You can find notes on our back-up service at the end of this documentation.

**Caution when engine is running**

Shut the engine down before performing maintenance and repair work. If any safety fixtures are removed, refit these after concluding the work. When working on a running engine, work clothes must be tightly fitting and may not hang loose.

**Safety**

All safety instructions are marked by this symbol. Observe these carefully. Also pass on safety instructions to your operating personnel. In addition, observe the "General Safety and Accident Prevention Regulations" applicable by law.

**Note**

Notes of a general nature are marked by this symbol. Observe these carefully.

**Asbestos**

The seals used with this engine do not contain asbestos. Please use corresponding spare parts when undertaking maintenance and repair work.



**0 Introduction**

Editorial, foreword, quick access, contents

**1 User instructions**

- 1.1 General
- 1.2 Regulations
- 1.3 Operating instructions and workshop manual
- 1.4 Work cards
- 1.5 Key to symbols

**2 Technical Data****3 Work cards**

- 3.1 Overview work cards, alphabetical
- 3.2 Overview work cards, numerical

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## **1 User instructions**

- 1.1 General**
- 1.2 Regulations**
- 1.3 Operating instructions and workshop manual**
- 1.4 Work cards**
- 1.5 Key to symbols**



## 1

## 1 User instructions

### 1.1 General

The maintenance work prescribed in the operating instructions and the workshop manual must be performed to schedule and in the full scope.

Maintenance personnel must have the skills necessary to perform the work. Any safety fixtures and protective equipment needing to be dismantled during maintenance work must be refitted.



#### Caution

It is essential to observe the safety and accident prevention regulations during maintenance work.

In this context, also comply with the specific safety provisions for the different maintenance groups which are described in detail as work cards in the chapter on work cards (compare section 1.2).

Maintenance intervals are contained in the maintenance schedules. These also provide information on the work to be performed.

The work cards give technical advice on how to undertake the work.

### 1.2 Regulations

#### Safety and accident prevention regulations

Detailed safety instructions have been compiled for the different maintenance groups in the form of work cards, these precede the work cards of the respective maintenance groups.

Observe the accident prevention regulations laid down by law (available from trade associations or specialist outlets). These depend on the place of installation, the operating mode and the consumables and auxiliary aids used.

Special protective action dependent on the respective work is specified and marked in the description of the work.

In general, the following applies

- to personnel:
  - Only instructed personnel may operate or service the engine. No unauthorised persons are allowed in the machine room.
  - Wear tightly clothing and hearing protection in the machine room when the engine is operating.
  - Only deploy skilled personnel for maintenance or repair work.
- to the machine room:
  - Provide adequate ventilation (do not cover air vents).
  - Install first-aid boxes and suitable fire extinguishers. Check that these are filled and ready to use at regular intervals.
  - Do not store inflammable materials in the machine room unless these are required to operate the equipment.
  - Smoking and naked flames are forbidden in the machine room.



- to operating and maintaining the engine:
  - Do not start the engine unless all safety fixtures are installed. Ensure that no-one is loitering in the danger zone.
  - Shut the engine down and secure against re-starting before starting cleaning, maintenance and repair work.

### Disposal regulations

The work described in the operating instructions and the workshop manual occasionally requires the renewal of parts and operating materials. These replacement parts / operating materials must be stored, transported and disposed of according to the regulations. The operator is responsible for this.

Disposal includes the recycling and scrapping of parts / operating materials, whereby recycling has priority.

Details on disposal its monitoring are regulated by regional, national and international laws and decrees. It is the responsibility of the plant operator to comply with these.

The servicing documentation has been sub-divided into operating instructions and workshop manual in order to structure the information in the best way for the users.

Among other things, the **operating instructions** contain a general description of and a guide to all maintenance work required

They contain the following chapters:

- 1 General, table of contents
- 2 Engine description
- 3 Operating
- 4 Operating materials
- 5 Maintenance
- 6 Servicing and maintenance work
- 7 Troubleshooting
- 8 Engine conservation
- 9 Technical specifications
- 10 Service

The **workshop manual** requires prior knowledge of the contents of the operating instructions, this applies in particular to the safety regulations. Simple repairs and emergency action on components are described which necessitate a larger scope of work and correspondingly skilled personnel.

## 1.3 Operating instructions and workshop manual

## 1

## 1.4 Work cards

The **work cards** are differentiated into those associated with the **workshop manual** e.g. W 4-5-1 and those with the **maintenance instructions** I 4-5-1.

- Please refer to Fig. 1 for an explanation on how the work cards are numbered.
- Fig. 2 shows the shows the layout of a work card.

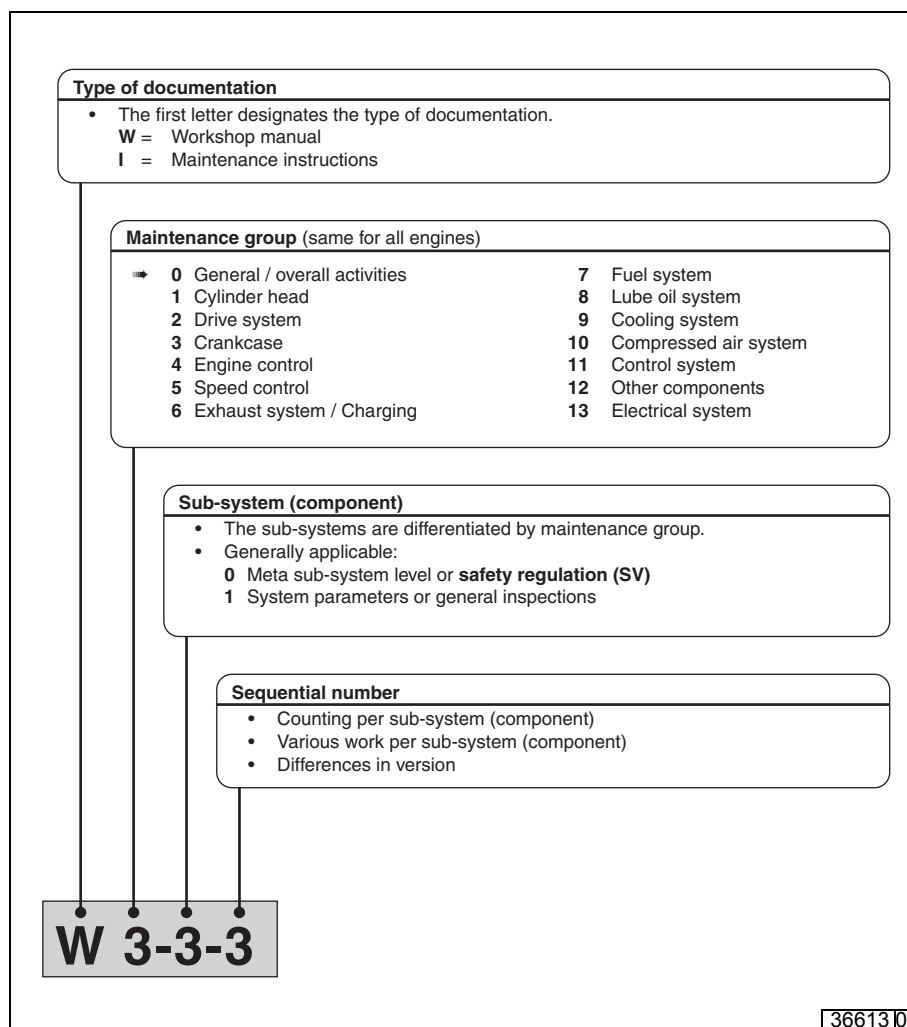


Fig. 1 Numbering of work cards

- 1 DEUTZ, issuer of the servicing documentation
- 2 Engine type (e.g. 914)
- 3 Maintenance group
- 4 Work card number
- 5 Reference to other work cards, regulations etc.
- 6 Explanatory graphics
- 7 Page number
- 8 DEUTZ internal part number of the work card and technical categorisation number
- 9 Date the work card was issued
- 10 Sequence of work
- 11 Safety references and general notes
- 12 Tools, auxiliary aids and spare parts required
- 13 Title of the work card










Should you have further questions on a work car, please always quote the engine type (2), the number of the work card (4), the page number (7), the date of issue (9) or alternatively the DEUTZ internal part number (8).





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1.5 Key to symbols

	Caution, important note			Note e.g. cylinder head has been dismantled
	Auxiliary aids e.g. lifting gear, adhesive			Always renew when reassembling e.g. gaskets
	Tools e.g. dial gauge 100 400			References e.g. work card nr. W x-y-z
				See technical specifications line reference, e.g. 67

**Technical Data**

 000	General engine data	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
001	Engine weight according to DIN 70020-A  approx. kg	277	307	380	430	320	350	485/510
002	Total engine volume  cm <sup>3</sup>	3.236	4.314	5.393	6.472	3.236	4.314	6.472
003	Bore  mm	102						
004	Stroke  mm	132						
005	Direction of rotation	When facing flywheel counter-clockwise						
006	Rated speed max. min <sup>-1</sup>	2.500 to 2.800						
007	Minimum idle speed min <sup>-1</sup>	650 to 700						
008	Working cycle	Four-stroke diesel						
009	Combustion system	Direct injection						


 010	General engine data	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
010	Compression ratio	20				18		
011	Compression pressure MPa (bar)	20 to 30 (20 to 30)						
012	Firing order	1-2-3	1-3-4-2	1-2-4- 5-3	1-5-3- 6-2-4	1-2-3	1-3-4-2	1-5-3- 6-2-4
020	Dimensions of engine including standard adapter housing (normal)							
021	Maximum length mm				1.012			1.012
022	Maximum width mm				739			739
023	Maximum height mm				1.176			1.176

 040	General engine data	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
040	Lube oil pressure at low idling at 650 rpm <sup>-1</sup> . without engine-oil heating. temperature approx. 120°C Oil SAE 15W/40m minimum MPa / (bar)	0.4				0.5		
041	Opening pressure of pressurestat MPa (bar) Lube oil pump: 40 + 60 liter / min. 70 + 80 liter / min.	5.5 to 6.5 (5.5 to 6.5) 5.0 to 6.0 (5.0 to 6.0)						
045	V-belt tension First-time assembly N	450 + 20						
046	V-belt tension Check after running 15 min under load N	300 + 20						
047	V-belt tension if re-used N	300 + 20						

100	Injection system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
110	Injection pump	Motorpal						
111	Make type	PPM10Pi ...						
112	Minimum pressure which must be attained at approx. 5 KW revolutions MPa (bar)	300 (300)						
113	Test pressure for checking the tightness of pressure P-degree (dynamic) MPa (bar)	The pressure may drop from 150 to min. 140 after 1 min.						
120	Governor	Motorpal						
121	Make type	RV3M350/1150-3864						




130	Injection system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
130	Injector	Bosch						
131	Injector type	DLLA 146 ...						
133	Injector opening pressure target value MPa (bar)	200 + 10 (200 + 10)						


	Injection system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
140	Commencement of delivery	2)						
141	Static. <b>without</b> injection timing mechanism	0%						
142	Static. <b>with</b> injection timing mechanism	6%						


2) Engine output, speed and commencement of delivery are stamped on the engine nameplate.



150	Injection system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
150	Injection timing mechanism							
151	Adjustment range Degree KW	6° to 12° (see 141. 142)						
152	Adjustment start min <sup>-1</sup>	1.200						
153	Adjustment end min <sup>-1</sup>	2.800						

200	Cylinder head	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
200	Cylinder head							
210	Valve guide							
211	Valve guide Outer diameter mm	15 <sup>+0.056</sup> <sub>+0.045</sub>						
212	Valve guide bore in cylinder head mm	15 <sup>+0.011</sup>						
213	Valve guide (pressed in) inner diameter mm	8 <sup>+0.015</sup>						
220	Valve seat insert							
221	Valve seat insert Outer diameter Inlet mm	45.66 <sub>-0.02</sub>						
222	Valve seat insert Outer diameter Exhaust mm	40.16 <sub>-0.02</sub>						

 223	Cylinder head	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
223	Valve seat insert Inlet bore mm	45.5 <sup>+0.025</sup>						
224	Valve seat insert Exhaust bore mm	40.0 <sup>+0.025</sup>						
230	Valve							
231	Valve stem Diameter Inlet mm	7.945 to 7.960						
232	Valve stem Diameter Exhaust mm	7.920 to 7.940						
233	Valve stem clearance Inlet normal mm	0.045 to 0.075						
234	Valve stem clearance Inlet Wear limit mm	0.15						
235	Valve stem clearance Exhaust normal mm	0.065 to 0.100						


		Cylinder head	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
236		Valve stem clearance Exhaust Wear limit mm	0.20						
237		Valve disc diameter Inlet mm	42.9 to 43.10						
238		Valve disc diameter Exhaust mm	36.90 to 37.10						
239		Valve seat width Inlet mm	3.00						
240		Valve seat width Exhaust mm	2.50						
241		Valve seat angle Inlet Degree	30						
242		Valve seat angle Exhaust Degree	45						
243		Valve edge thickness Inlet normal mm	1.80						
244		Valve edge thickness Exhaust normal mm	1.50						


 245	Cylinder head	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
245	Valve edge thickness Inlet Wear limit mm	1.30						
246	Valve edge thickness Exhaust Wear limit mm	1.00						
250	Valve spring							
251	Number per valve	1						
252	Total windings	7						
253	Length untensioned normal mm	59 ± 1.9						
254	Length untensioned Wear limit mm	56.00						

		Cylinder head	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
260		Valve clearance							
261		Inlet with cold engine mm	0.15 <sup>+0.05</sup>						
262		Exhaust with cold engine mm	0.15 <sup>+0.05</sup>						
270		Distances to be checked							
271		Valve recess distance normal mm							
272		Wear limit mm	5.50						
273		Recess of cylinder head bottom relative to cylinder head sealing surface normal mm	5.30 <sup>+0.08</sup>						
274		Wear limit mm	4.80						



280	Cylinderhead	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
280	Cylinder head bolts	4						
281	Length normal mm	217 ± 0.5						
282	Length limit value mm	218.50						


	 300	Crankcase	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
300		Cylinder							
301		Bore normal mm				102.0 <sup>+0.05</sup> <sub>+0.01</sub>			
302		Bore Wear limit mm				0.1			
303		Number of oversizes				1			
304		Limit value for oversize mm				0.5			

 400	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
400	Piston							
401	Diameter normal mm	102				101.89 <sup>-0.11</sup>		
402	Number of oversizes	1						
403	Limit value for oversize mm	0.5						
404	Piston clearance to cylinderhead mm	Suction engine< 1800 min <sup>-1</sup> 0.8 to 0.9				0.9 to 1.0		1.00 to 1.10
		Suction engine> 1800 min <sup>-1</sup> 0.9 to 1.0						
405	Bore for piston pin mm	40 <sup>+0.009</sup> <sub>+0.003</sub>						
406	Piston pin diameter mm	40 <sup>-0.006</sup>						

410	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
410	Piston ring groove diameter mm	(1.) 92.5 (2.) 92.5 (3.) 93.3						
411	1st ring groove Double trapezoid groove mm	3 <sup>+0.03</sup> 1)						
412	2nd ring groove Double trapezoid groove mm	3 <sup>+0.03</sup> 1)						
413	3rd ring groove Rectangular groove mm	3 <sup>+0.05</sup> <sub>+0.03</sub>						
420	Piston rings	3 pieces						
421	Axial end float normal 1st ring Double trapezoid ring mm	0.06						
422	Wear limit mm	0.15						

1) Double-sided trapezoid ring. Check with groove gauge.


423	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
423	Axial end float normal 2nd ring Double trapezoid ring mm	0.1						
424	Wear limit mm	0.15						
425	Axial end float normal 3rd ring Bevel-edge slotted oil ring mm	0.04 to 0.072						
426	Wear limit mm	0.15						
429	Gap clearance normal 1st ring mm	0.3 to 0.5						
430	Wear limit mm	0.80						
431	Gap clearance normal 2nd ring mm	0.8 bis 1.0						

	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
432	Wear limit mm	0.80						
433	Gap clearance normal 3rd ring mm	0.25 to 0.4						
434	Wear limit mm	0.80						
435	1st ring Double trapezoid ring Size	102 x 93.4 x 2.94 GV-MO						
436	2nd ring Double trapezoid ring Size	102 x 93.4 x 3 K-CR						
437	3rd Ring Bevel-edge slotted oil ring Size	102 x 94.5 x 3 OE VO						

500	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
500	Crankshaft							
510	Crank pin	3	4	5	6	3	4	6
511	Crank pin width normal mm	34 <sup>+0.2</sup> <sub>0</sub>						
512	Crank pin diameter normal I (lift) mm	66 <sup>-0.01</sup> <sub>+0.029</sub>						
514	Oversize per stage mm	0.50						
515	Limit value for oversize stage mm	38.025						
516	Crank pin ovality Wear limit mm	0.01						
517	Chamfer radius mm	R1.9 <sup>+0.05</sup> = 0.25 <sup>+0.075</sup>						


518	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
518	Crank pin hardness normal HRC (Effective hardening depth)	55 min (2.8 max)						
519	Limit value HV 1 D Core hardness	- + - HB 2.5/187.5						
520	Main bearing journal							
521	Journal width normal mm	36 <sup>+0.03</sup> <sub>+0</sub>						
522	Journal diameter normal I mm	75 <sup>-0.01</sup> <sub>-0.029</sub>						
524	Undersize stage mm	0.25						
525	Limit value for undersize stage mm	73.5 <sup>-0.01</sup> <sub>-0.029</sub>						
526	Journal ovality Wear limit mm	0.01						




	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
527	True running max. permissible mm	0.06 to 0.08						
528	Chamfer radius mm	R 2.05 $\pm 0.05$						
529	Journal hardness normal HRc	55 min.						
530	Limit value HV 10 Core hardness	- + - HB 2.5/187.5						
540	Thrust bearing journal							
541	Journal width normal I mm	35.97 $^{-0.11}_{-0.243}$						
542	Journal width normal II mm	36.4 $^{+0.02}_{+0.00}$						
543	Oversize per stage mm applies including any oversize stage	0.4 max.						
544	Limit value for oversize stage mm	38 $^{+0.025}$						

550	Drive system	F3L	F4L	F5L	F6L	BF3L	BF4L	BF6L
		914	914	914	914	914/T	914/T	914 C/T
550	Main bearing							
551	Bearing shell Inner diameter normal I mm				75.04	<sup>-0.043</sup>		
552	Bearing shell Inner diameter normal II mm				75	<sup>-0.01</sup> <sub>-0.029</sub>		
553	Undersize per stage mm				0.25	<sup>-0.075</sup> <sub>-0</sub>		
554	Limit value for undersize stage mm				78.5	<sup>±0.02</sup>		
555	Radial clearance normal mm				0.05			
556	Radial clearance Wear limit mm				0.15			
560	Main bearing bore							
561	Bearing bore in crankcase normal mm				79	<sup>+0.019</sup>		

562	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
562	Bearing bore in crankcase Oversize stage mm	79.5 <sup>+0.019</sup>						
570	Thrust bearing (with thrust rings)							
571	Outer distance of thrust rings normal I mm	35.97 <sup>-0.110</sup>						
572	Outer distance of thrust rings normal II mm	36.8 <sup>-0.139</sup>						
573	Oversize per stage mm	0.25						
574	Limit value for oversize stage mm	37.45 <sup>-0.133</sup>						
575	Crankshaft axial end float normal mm	0.15 to 0.40						
576	Wear limit mm	0.4						


	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
600	Connecting rod	for parallel pistons						
601	Mid-distance from small end bush and bore for big end bearing mm	216 <sup>-0.1</sup>						
602	Bore for small end bush mm	43 <sup>+0.016</sup>						
603	Small end bush Outer diameter mm	43.05 <sup>+0.03</sup>						
604	Small end bush Inner diameter pressed-in mm	40.040 to 40.084						
605	Small end bush clearance mm	0.04 to 0.09						
606	Wear limit mm	0.15						
607	Bore for big end bearing mm	70.000 <sup>+0.019</sup>						
608	Big end bearing shells Inner diameter normal mm	66.030 to 66.069						

	Drive system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
609	Big end bearing shells Inner diameter normal II mm	66 (65.971 to 65.990)						
610	Undersize per stage mm	0.25						
611	Limit value for undersize stage mm	64.530 to 64.569						
612	Big end bearing - radial clearance normal mm	0.040 to 0.098						
613	Big end bearing - radial clearance Wear limit mm (without heating up)	0.15 <sup>+0.2</sup>						
614	Big end bearing width mm	27 <sub>-0.3</sub>						
615	Connecting rod width mm	33.6 <sub>-0.142</sub> <sup>-0.08</sup>						
616	Connecting rod - axial end float normal mm	0.48 to 0.581 <sup>1)</sup> 0.48 to 0.619 <sup>2)</sup>						
617	Connecting rod - axial end float Wear limit mm	0.8						

1) with weight balancing


2) without weight balancing

		F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
700	Engine control							
700	Camshaft, intermediate gear, bearing journal, Mass balancing gear (MAG)							
710	Camshaft							
711	Axial end float normal mm				0.3 to 0.7			
712	Axial end float Wear limit mm				1			
713	Camshaft bearing Inner diameter normal mm				48 <sup>-0.05</sup> -0.095			
714	Radial clearance normal mm				0.03 to 0.1			
715	Radial clearance Wear limit mm				0.2			
716	Cam lift Inlet mm		7.85 ±0.1		8 ±0.1	-		7.1 ±0.1
717	Cam lift Exhaust mm		8 ±0.1			-		7.4 ±0.1

 720	Engine control	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
720	Valve timing with adjusted valve clearance mm							
721	Inlet opens before TDC Degree at 0.15 mm valve clearance	34° 30'					27° 24'	32° 24'
722	Inlet closes after BDC Degree at 0.15 mm valve clearance	65° 30'	89° 30'	65° 30'			45° 24'	40° 24'
723	Exhaust opens before BDC Degree at 0.15 mm valve clearance	76° 30'	100° 30'	76° 80'			87° 44'	83° 44'
724	Exhaust closes after TDC Degree at 0.15 mm valve clearance	35° 30'	59° 30'	35° 30'			29° 44'	33° 44'
730	Intermediate gear Bearing journal Diameter mm	48 <sup>-0.05</sup> <sub>-0.066</sub>						
731	Bearing bush Inner diameter pressed in mm	47.980 <sup>+0.054</sup>						
732	Bearing journal diameter mm	47.4 <sup>+0.1</sup>						
733	Radial clearance of bearing journal in the bush normal mm	0.030 to 0.100						



2

	Engine control	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
734	Wear limit mm	0.10						
735	Axial end float mm	0.15						
740	Mass balancing gear							
741	Backlash mm	0.10 to 0.15						

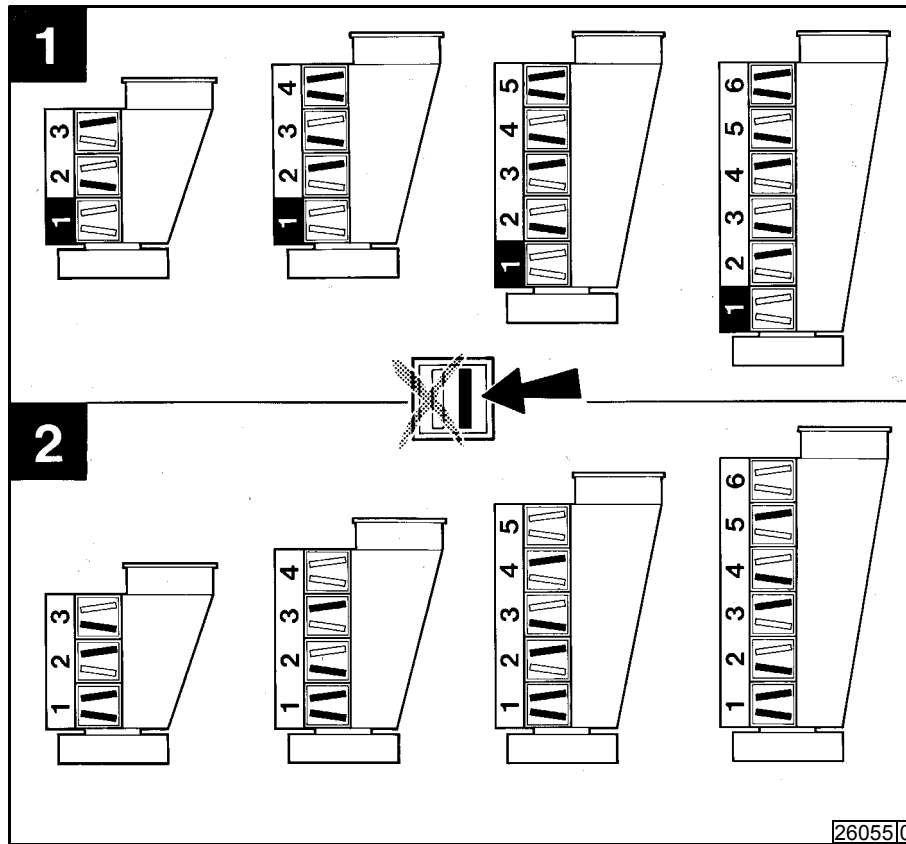


800	Lube oil system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
800	Lube oil pump	80 l/min with MAG - 70 l/min						
801	Axial end float of conveyor wheels normal mm	0.025 to 0.04						
802	Axial end float of conveyor wheels Wear limit mm	0.025 to 0.090						
803	Distortion backlash Camshaft gear mm	0.02 to 0.1						
804	Backlash drive gear to crankshaft gear	0.1 <sup>-0.1</sup>						
810	Lube oil pressure							
811	End control valve Pe(oil) (bar)	min. 8.5 to max. 10						
812	Lube oil pressure at low idle minimum hPa (bar)	0.4						
813	Safety valve on lube oil pump hPa (bar)							

814	Lube oil system	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
814	Bypass valve on lube oil cooler hPa (bar)							
815	Bypass valve on filter housing hPa (bar)							
835	Ventilator system							
850	Exhaust thermostat clearance between expansion element and ball mm	0.02 <sup>+0.01</sup>						
860	Shaft seal recess to support surface mm	0.10 to 0.50						


870	Schematic for valve clearance adjustment	F3L 914	F4L 914	F5L 914	F6L 914	BF3L 914/T	BF4L 914/T	BF6L 914 C/T
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870



● Crankshaft position 1: **1**

Turn crankshaft until both valves overlap on the first cylinder. Adjust the valve clearance as shown in the adjustment schematic (black designation). Mark each rocker arm with chalk to check the adjustment performed.

 The valves designated in black are ready for adjustment.

● Crankshaft position 2: **2**

Turn crankshaft by one further revolution (360°). Adjust the valve clearance as shown in the adjustment schematic (black designation).

2605510



900	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
901	Bolts for filter bracket and change-over housing	25 Nm	50 Nm + 5 Nm
902	Cylinder head bolts	30 Nm to 45 Nm	45° + 45° + 45° + 30°
903	Connecting rod bolts	20 Nm to 30 Nm	60° + 30°
904	Main bearing bolts	20 Nm to 30 Nm	60° + 45°
905	Flywheel bolts	30 Nm	M10 x 1 x 30-50 = 60° M10 x 1 x 55-60 = 60° + 30° M10 x 1 x 75-80 = 60° + 60°
908	V-belt pulley bolt	50 Nm	210°
909	V-belt pulley nut	M8 = 21 Nm M10 = 40 Nm	

910	Table for bolt tightening torques	Initial tightening torque Nm	Initial tightening torque Final tightening torque Nm
910	Injector fastening	25 to 30 Nm + 5 Nm	
911	Intermediate gear bearing bolt	27 Nm to 33 Nm	30° + 30°
912	Nut on injection pump drive	80 Nm + 10 Nm	
913	Positioning bolt sleeve on injection pump	40 Nm to 50 Nm	
914	Injection valve cap nut	30 Nm +10 Nm	
915	Pipe clip injection lines	9 Nm	
916	Rocker arm nut	28 Nm + 3 Nm	
917	Cylinder head cover bolt	12 ±1.3 Nm	
918	Sealing nut for blower	50 Nm	90°

919	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
919	Sealing nut for hydraulic blower	50 Nm	90°
920	Cylinder bolt for hydraulic blower	8.5 Nm + 3 Nm	
921	Screw plug	68 Nm to 84 Nm	
922	Bolts for bearing traverses, mass balancing gear (MAG)	30 Nm	
923	Hex nut mass balancing gear (MAG)	100 Nm	
924	Bolt for drive gear mass balancing gear (MAG)	20 Nm	60°
925	Cap nut for oil suction pipe	M28 x 1.5 = 100 Nm to 120 Nm M33 x 2.0 = 145 Nm to 165 Nm M36 x 2.0 = 145 Nm to 165 Nm	
926	Fastening bolts for lube oil pumps Pressure scavenging pump	31.5 Nm to 38.5 Nm	
927	Rocker arm lock nut	22 ± 2 Nm to 24 Nm	

## 2

928	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
928	Injection lines lock nut	22 Nm to 28 Nm	
929	Injection pump drive bolts	25 Nm	
930	Idler pulley bolts	21 Nm	
931	Exhaust thermostat nut	15 Nm to 20 Nm	
932	Oil pressure line	33 Nm to 37 Nm	
933	Control line	38 Nm to 42 Nm	
934	Cooling air line	7.5 Nm to 9.5 Nm	
935	Expansion pin housing exhaust thermostat	50 Nm	
936	Blanking plug with special sealing ring	80 Nm to 100 Nm	



937	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
937	Blanking plug with Cu-rings	18 Nm to 22 Nm	
938	Blanking plugs, coated with sealing compound	51 Nm to 61 Nm	
939	Oil spray nozzles	8 Nm to 10 Nm	
940	Idler pulley cover	2 Nm to 3 Nm	
941	Injection pump nut	40 Nm to 48 Nm	
942	Injection pump drive bolts	22 Nm to 28 Nm	
943	Rear cover	20 Nm to 24 Nm	
944	Adapter housing	30 Nm	50°
945	Cylinder head bolts for measuring piston crown clearance	40 Nm	45°

946	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
946	Bolts for oil suction pipe	M6 = 7.5 Nm to 9.5 Nm M8 = 19 Nm to 23 Nm	
947	Front cover	20 Nm to 24 Nm	
948	Cover on front cover	M8 = 20 Nm to 24 Nm M10 = 38 Nm to 46 Nm	
949	Idler pulley	21 Nm	
950	Oil pan	22 Nm to 28 Nm	
951	Holding plate with bush	22 Nm to 28 Nm	
952	Fastening bolt	M22 x 1.5 = 80 Nm M30 x 1.5 = 150 Nm	
953	Blanking plug	75 Nm to 95 Nm	
954	Lube oil cooler bolts	17 Nm to 19 Nm	

955	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
955	Cap boltsblock-type oil cooler	81 Nm to 99 Nm	
956	Cap boltsgilled tube oil cooler	58.5 Nm to 71.5 Nm	
957	Cap bolts short-circuit pipe	85 Nm to 105 Nm	
958	Bolts for cooling air ducting	M6 = 7.5 Nm to 9.5 Nm M8 = 19 Nm to 23 Nm	
959	Blower bolts	20 Nm to 24 Nm	
960	Leak fuel line	18 Nm + 2 Nm	
961	Oil pressure switch	10 Nm + 10 Nm	
962	Filter bracket	17 Nm to 19 Nm	
963	Starter	36.5 Nm to 44.5 Nm	

964	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
964	Air intake manifold	25 Nm + 3 Nm	
965	Exhaust manifold	40 Nm + 4 Nm	
966	Alternator bracket	21 Nm	
967	Grounding cable	40.5 Nm	
968	Rubber buffer bolts, alternator	21 Nm	
969	Cap bolts	81 Nm to 99 Nm	
970	Stay plate bolts	16 Nm + 20 Nm	
971	Covering plate bolts	M6 = 7 Nm to 9 Nm M8 = 17 Nm to 21 Nm	
972	Flange turbocharger	21 Nm	

973	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque
973	Lube oil line turbocharger	20 Nm to 24 Nm	
974	Turbocharger on exhaust pipe elbow	20 Nm + 35 Nm + 50 Nm + 10 Nm	
975	Lube oil line on engine block	28 Nm to 32 Nm	
976	Exhaust pipe elbow	20 Nm + 20 Nm + 35 Nm + 50 Nm + 10 Nm	
977	Elbow	21 Nm	
978	Hose clamps	4 Nm to 5 Nm	
979	Return pipe	21 Nm	
980	Suction elbow bolt	21 Nm	
981	Vibration damper Hex, 8.8 Cylinder bolts, 10.9	19 Nm to 23 Nm 25 Nm + 5 Nm	

## 2

982	Table for bolt tightening torques	Initial tightening torque Nm	Final tightening angle ° / Final tightening torque Nm
982	Nut on blower	30 Nm	90°
983	Tensioning nut for injection timing mechanism	170 to 190 Nm	
984	Bolt for fuel filter on fuel filter bracket	36 to 44 Nm	
985	Bolt for fuel line on injection pump	34 to 40 Nm	
986	Charging air cooler on air suction pipe	18 Nm	

### 3.1 Work card overview, alphabetical

Designation of component group / activity	Work card	Maintenance group
Injection pump, checking and setting	view repair instructions	-
Injection pump, repairing	view repair instructions	-
Adapter housing, removing and refitting	W 3-9-4	Crankcase
Air suction pipe, removing and refitting	W 6-7-3	Exhaust system /charging
Blower, dismantling, reassembling and checking	W 9-11-2	Cooling system
Blower, removing and remounting	W 9-11-1	Cooling system
Camshaft, checking	W 4-5-6	Engine control
Camshaft, removing and refitting	W 4-5-5	Engine control
Change-over cock / filter carrier, removing and remounting	W 8-11-7	Lube oil system
Commencement of delivery, with high-pressure pump, checking and setting	W 7-6-2	Fuel system
Commencement of delivery, with positioning bolt, checking and setting	W 7-6-1	Fuel system
Compression pressure, checking	W 0-2-6	General
Connecting rod, checking	W 2-3-1	Drive system
Cooling air ducting, removing and remounting	W 9-11-3	Cooling system
Crankcase, reworking	W 3-10-1	Crankcase
Crankshaft seal (coupling side) on complete engine, renewing	W 2-2-2	Drive system
Crankshaft seal (opposite end to coupling) on complete engine, renewing	W 2-2-4	Drive system
Crankshaft, checking	W 2-1-7	Drive system
Crankshaft, removing and refitting	W 2-4-1	Drive system
Cylinder head sealing surface, reworking	W 1-4-8	Cylinder head
Cylinder head, removing and refitting	W 1-4-4	Cylinder head
Cylinder, checking	W 3-3-1	Crankcase
Engine on assembly stand, mounting and dismantling	W 0-5-1	General
Exhaust manifold, removing and remounting	W 6-1-5	Exhaust system / charging
Flywheel, removing and remounting	W 12-6-1	Other components
Front cover (opposite to coupling), removing and refitting	W 3-8-1	Crankcase
Fuel lines, removing and remounting	W 7-10-6	Fuel system
Injection lines, renewing	W 7-3-1	Fuel system
Injection pump intermediate gear, checking	W 4-4-8	Engine control
Injection pump intermediate gear, removing and refitting	W 4-4-7	Engine control

Designation of component group / activity	Work card	Maintenance group
Injection pump, removing and remounting	W 7-4-1	Fuel system
Injectors, checking and adjusting	W 7-7-5	Fuel system
Injectors, removing and refitting	W 7-7-1	Fuel system
Oil cooler, removing, remounting and cleaning	W 8-8-2	Lube oil system
Oil pan, removing and remounting	W 8-4-7	Lube oil system
Oil pump, removing and remounting	W 8-4-5	Lube oil system
Oil suction pipe, removing and refitting	W 8-4-6	Lube oil system
Piston and cylinder, removing and refitting	W 3-2-4	Crankcase
Piston crown clearance, measuring	W 1-4-9	Cylinder head
Piston rings and grooves, checking	W 2-10-3	Drive system
Pistons, checking	W 2-9-7	Drive system
Rear cover (opposite to coupling), removing and refitting	W 3-9-1	Crankcase
Rocker arm and rocker arm bracket, removing and refitting	W 1-2-2	Cylinder head
Rotary vibration damper, checking	W 12-2-3	Other components
Rotary vibration damper, removing and remounting	W 12-1-4	Other components
Starter ring gear on flywheel, renewing	W 12-6-3	Other components
Starter, removing and remounting	W 13-3-2	Electrical system
Three-phase alternator and support, removing and remounting	W 13-2-3	Electrical system
Tools, commercial	-	Commercial tools
Tools, special	-	Special tools
Top dead center, checking	W 1-2-5	Cylinder head
Turbocharger, removing and remounting	W 6-6-4	Exhaust system / charging
Valve clearance, checking and adjusting	W 1-1-1	Cylinder head
Valve guide, checking	W 1-6-3	Cylinder head
Valve guide, removing and refitting	W 1-6-2	Cylinder head
Valve recess, checking	W 1-7-8	Cylinder head
Valve seat inserts, removing, refitting and checking	W 1-7-3	Cylinder head
Valves, checking	W 1-5-4	Cylinder head
Valves, removing and refitting	W 1-5-1	Cylinder head
V-belt idler pulley, disassembling and reassembling	W 12-2-5	Other components



## 3.2 Work card overview, numerical

3

Work card	Designation of component group / activity	Maintenance group
view repair instructions	Repairing injection pump	-
view repair instructions	Checking and setting the injection pump	-
W 0-2-6	Checking compression pressure	General
W 0-5-1	Mounting and dismounting engine on assembly stand	General
W 1-1-1	Check and adjust valve clearance	Cylinder head
W 1-2-2	Remove and refit rocker arm and rocker arm bracket	Cylinder head
W 1-2-5	Checking the top dead center	Cylinder head
W 1-4-4	Removing and refitting the cylinder head	Cylinder head
W 1-4-8	Reworking the cylinder head sealing surface	Cylinder head
W 1-4-9	Measuring the piston crown clearance	Cylinder head
W 1-5-1	Removing and refitting the valves	Cylinder head
W 1-5-4	Checking the valves	Cylinder head
W 1-6-2	Removing and refitting the valve guide	Cylinder head
W 1-6-3	Checking valve guide	Cylinder head
W 1-7-3	Removing, refitting and checking valve seat inserts	Cylinder head
W 1-7-8	Checking the valve recess	Cylinder head
W 2-1-7	Checking the crankshaft	Drive system
W 2-2-2	Renewing the crankshaft seal (coupling side) on complete engine	Drive system
W 2-2-4	Renewing the crankshaft seal (opposite end to coupling) on complete engine	Drive system
W 2-3-1	Checking the connecting rod	Drive system
W 2-4-1	Removing and refitting the crankshaft	Drive system
W 2-9-7	Checking the pistons	Drive system
W 2-10-3	Checking the piston rings and grooves	Drive system
W 3-2-4	Removing and refitting the piston and cylinder	Crankcase
W 3-3-1	Checking the cylinder	Crankcase
W 3-8-1	Removing and refitting the front cover (opposite to coupling)	Crankcase
W 3-9-1	Removing and refitting the rear cover (opposite to coupling)	Crankcase
W 3-9-4	Removing and refitting the adapter housing	Crankcase
W 3-10-1	Reworking the crankcase	Crankcase
W 4-4-7	Removing and refitting the injection pump intermediate gear	Engine control

Work card	Designation of component group / activity	Maintenance group
W 4-4-8	Checking the injection pump intermediate gear	Engine control
W 4-5-5	Removing and refitting the camshaft	Engine control
W 4-5-6	Checking the camshaft	Engine control
W 6-1-5	Removing and remounting the exhaust manifold	Exhaust system / charging
W 6-6-4	Removing and remounting the turbocharger	Exhaust system / charging
W 6-7-3	Removing and refitting the air suction pipe	Exhaust system / charging
W 7-3-1	Renewing the injection lines	Fuel system
W 7-4-1	Removing and remounting the injection pump	Fuel system
W 7-6-1	Checking and setting the commencement of delivery, with positioning bolt	Fuel system
W 7-6-2	Checking and setting the commencement of delivery, with high-pressure pump	Fuel system
W 7-7-1	Removing and refitting the injectors	Fuel system
W 7-7-5	Checking and adjusting the injectors	Fuel system
W 7-10-6	Removing and remounting the fuel lines	Fuel system
W 8-4-5	Removing and remounting the oil pump	Lube oil system
W 8-4-6	Removing and refitting the oil suction pipe	Lube oil system
W 8-4-7	Removing and remounting the oil pan	Lube oil system
W 8-8-2	Removing, remounting and cleaning the oil cooler	Lube oil system
W 8-11-7	Removing and remounting the change-over cock / filter carrier	Lube oil system
W 9-11-1	Removing and remounting the blower	Cooling system
W 9-11-2	Dismantling, reassembling and checking the blower	Cooling system
W 9-11-3	Removing and remounting the cooling air ducting	Cooling system
W 12-1-4	Removing and remounting the rotary vibration damper	Other components
W 12-2-3	Checking the rotary vibration damper	Other components
W 12-2-5	Disassembling and reassembling of V-belt idler pulley	Other components
W 12-6-1	Removing and remounting flywheel	Other components
W 12-6-3	Renew starter ring gear on flywheel	Other components
W 13-2-3	Removing and remounting three-phase alternator and support	Electrical system
W 13-3-2	Removing and remounting the starter	Electrical system
–	Special tools	Special tools
–	Tools, commercial	Tools, commercial

## Checking the compression pressure



### Tools

- Commercial tools
  - Compression pressure tester \_\_\_\_\_ 8005
  - Claw wrench \_\_\_\_\_ 8018
- Special tools
  - Connector \_\_\_\_\_ 100 140
  - Extractor \_\_\_\_\_ 110 030
  - Extracting device \_\_\_\_\_ 120 630
  - Extracting device \_\_\_\_\_ 150 800

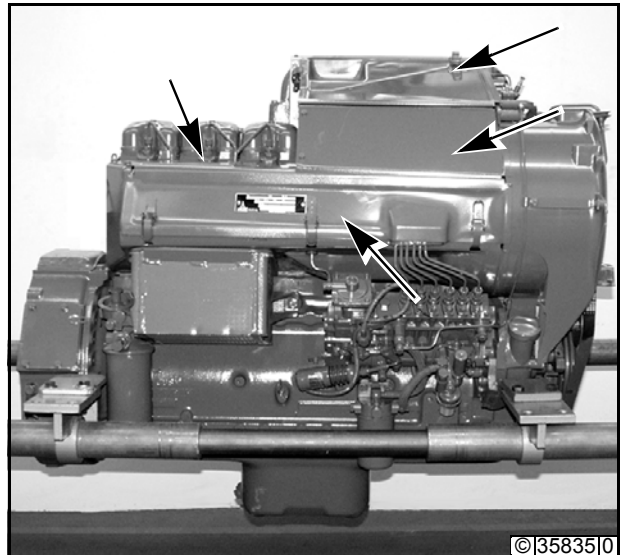


### References

- W 1-1-1
- W 7-3-1

### Disassembly

- Remove cooling air guide sheets.



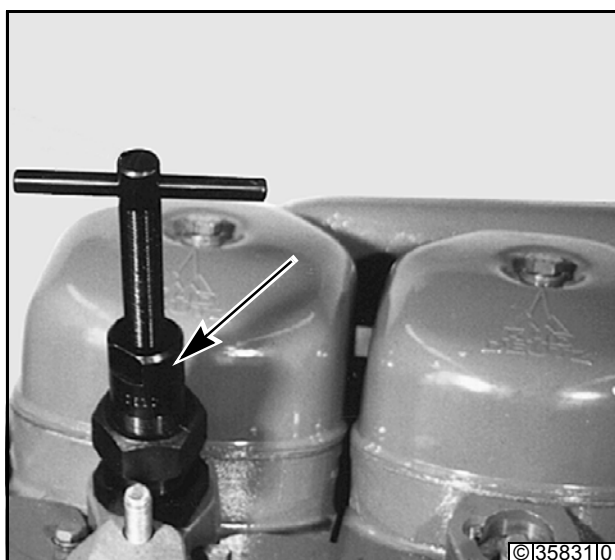
- Check valve clearance, adjust if necessary
  - see work card **W 1-1-1**.
- Remove injection lines
  - see work card **W 7-3-1**.
- Remove all injectors.





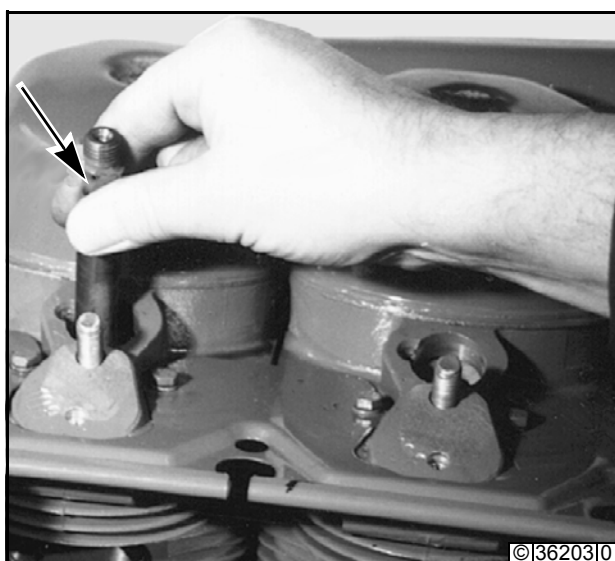
**Note**

If jammed, use extracting device **150 800** with extractor **110 030**.



**Note**

If sealing ring is jammed, use extracting device **120 630**.



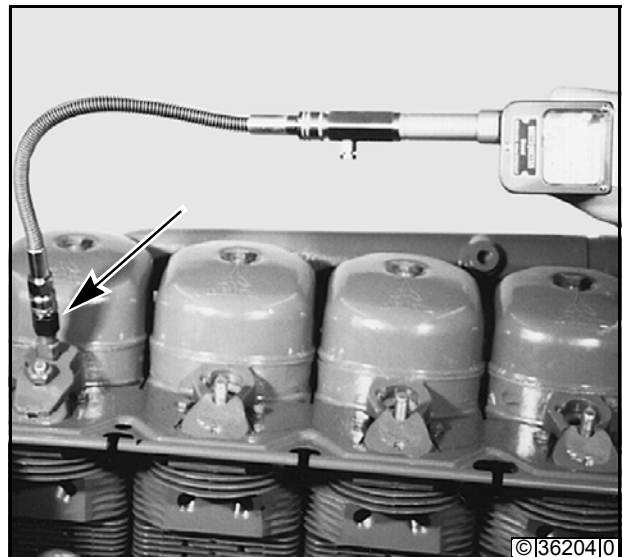
**Assembly**

- Insert connector with new sealing ring.

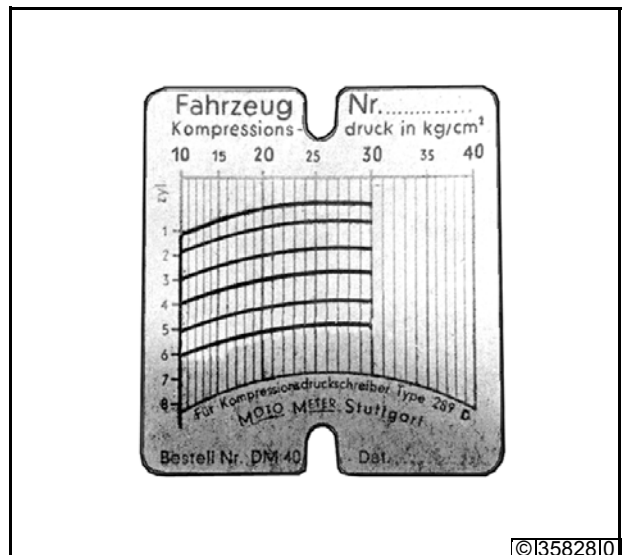
- Place on clamping pad. Tighten hex nut.



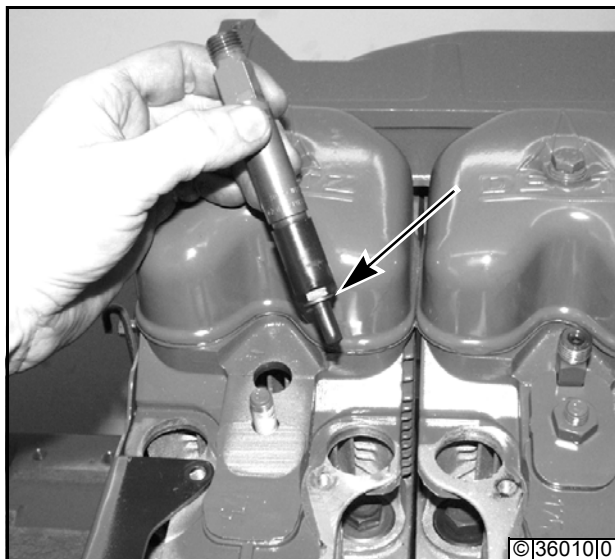
- Connect compression pressure tester. Crank engine with starter.



The measured compression pressure is dependent on the starting speed during the measurement process and on the altitude at which the engine is installed. It is therefore difficult to specify precise limit values. It is recommended that the compression pressure measurement should solely be regarded as a comparative measurement of all cylinders in one engine. If a difference in pressure in excess of **15 %** is measured, the cylinder unit concerned should be taken apart to establish the cause.



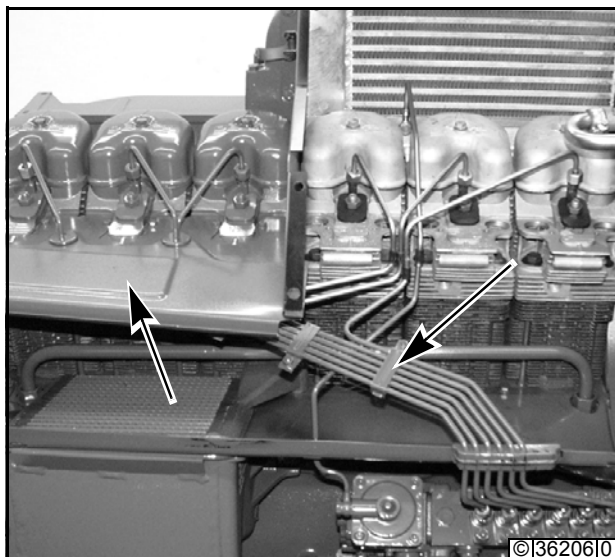




- Install all injectors with new sealing ring.



- Place on clamping pad. Tighten hex nut.

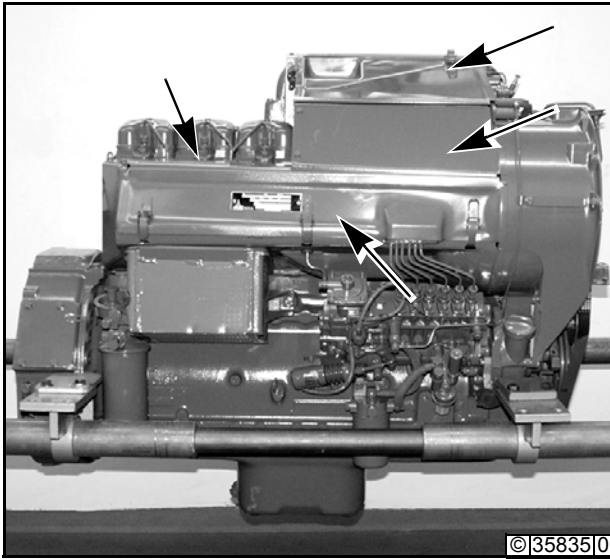


- Install new injection lines free of tension. Mount cooling air guide sheet with rubber grommets. Tighten cap nuts with claw wrench **8018**.



**Note**

Do not bend the injection lines. Bending them can create small rips which reduce long-term durability.



- Mount cooling air guide sheets.

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## Mounting and dismounting engine on assembly stand



### Tools

- Commercial tools
- Special tools
- Engine assembly stand \_\_\_\_\_ 6066
- Clamping angle \_\_\_\_\_ 6066/154

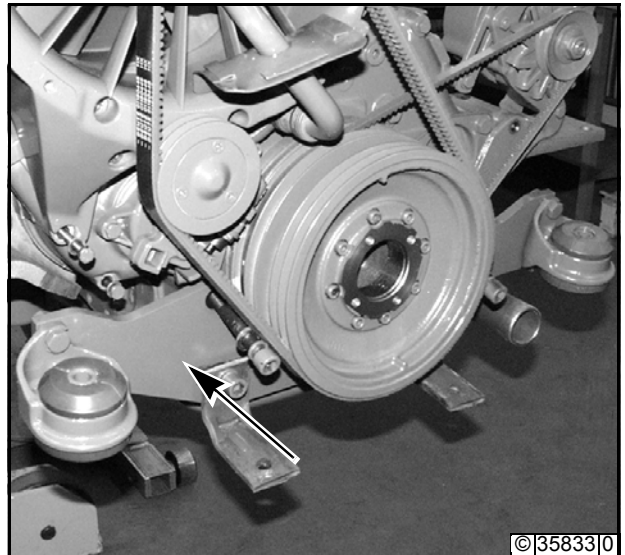


### Auxiliary aids

- Hoist
- Sturdy rope

### Mount engine on assembly stand

- Remove engine bearing.



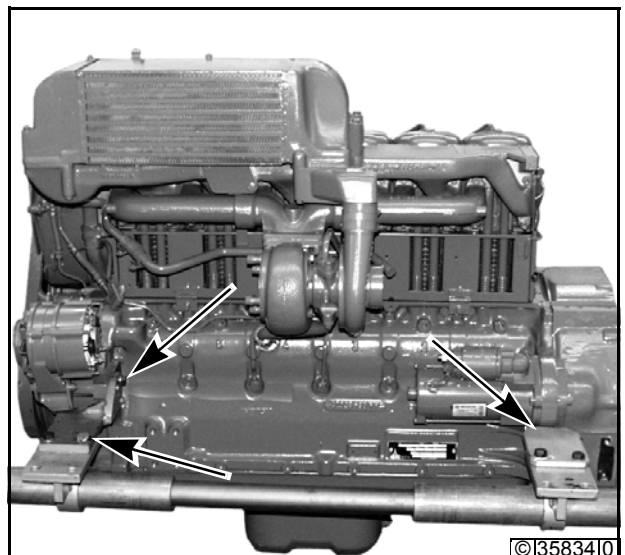
- Remove bolt from three-phase alternator.

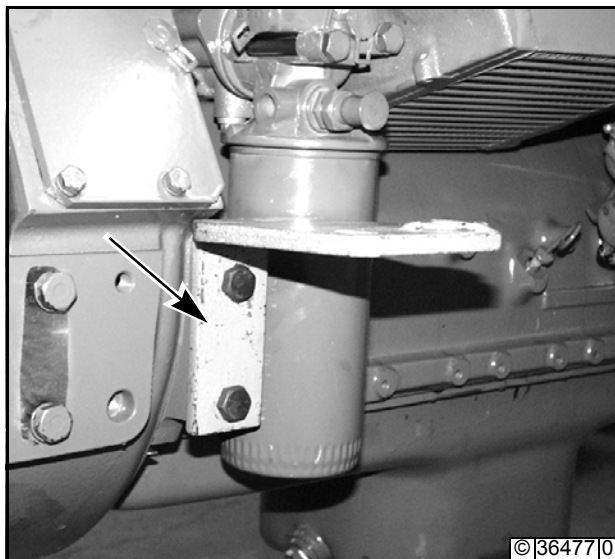


### Note

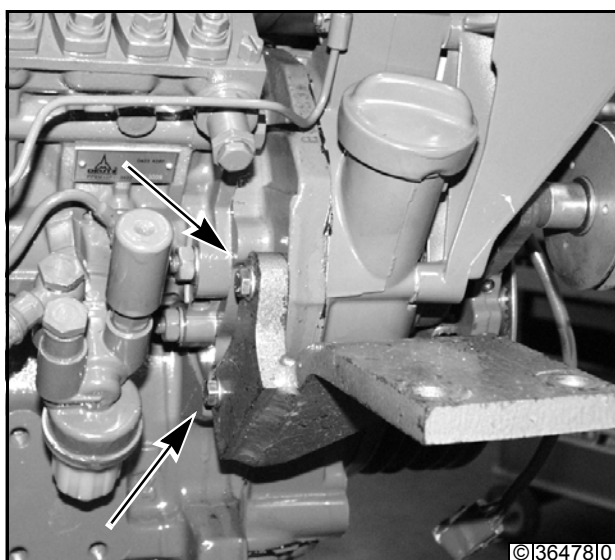
Bores serve to take up clamping angles.

- Mount clamping angles.
- Align engine on assembly stand and fasten.





- Mount clamping angles.



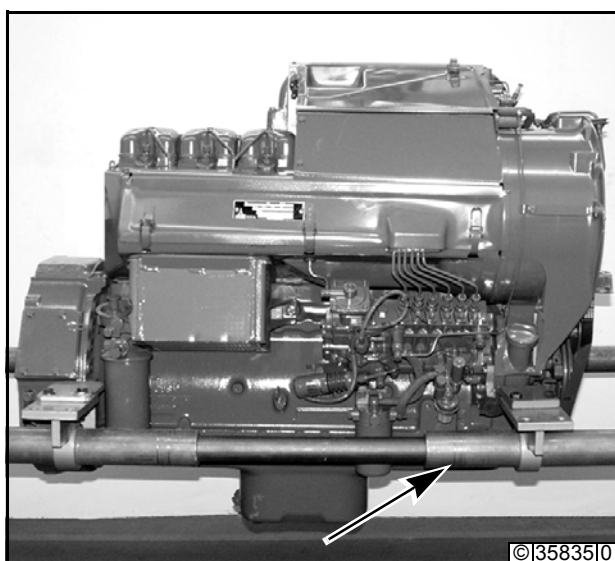
- Remove bolts from front cover.



**Note**

Bores serve to take up clamping angles.

- Mount clamping angles.



- Align engine on assembly stand and fasten.

**Check and adjust valve clearance****Tools**

- Commercial tools
- Special tools
- Feeler gauges \_\_\_\_\_ 101 630

**Auxiliary aids**

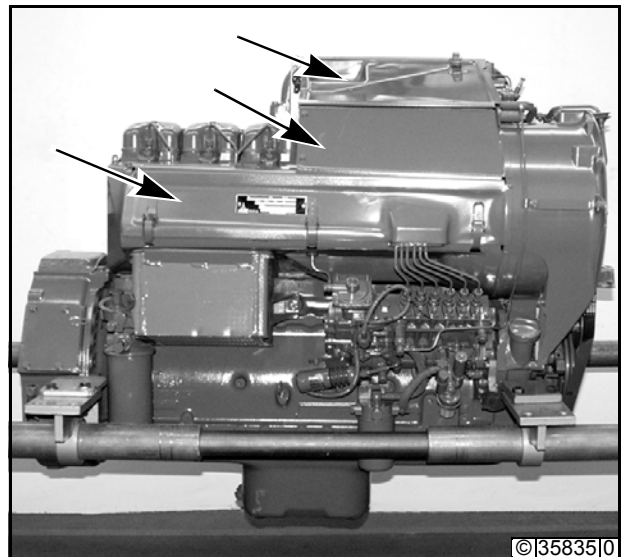
- DEUTZ KL 8

**Note**

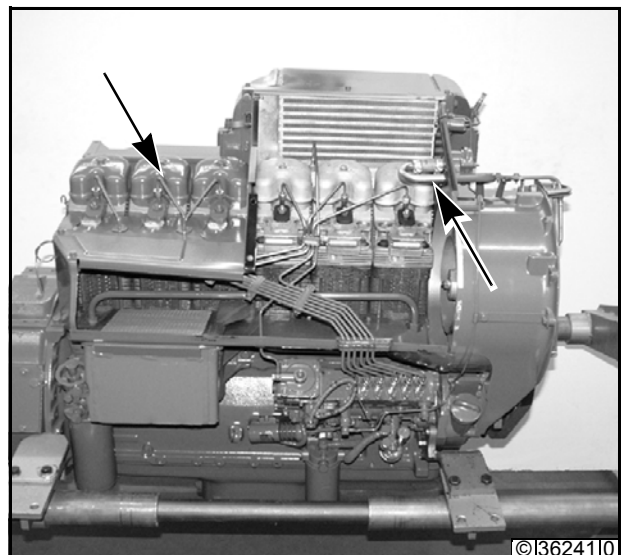
- Adjust valve clearance only with engine cold. The engine must have cooled down to ambient temperature.

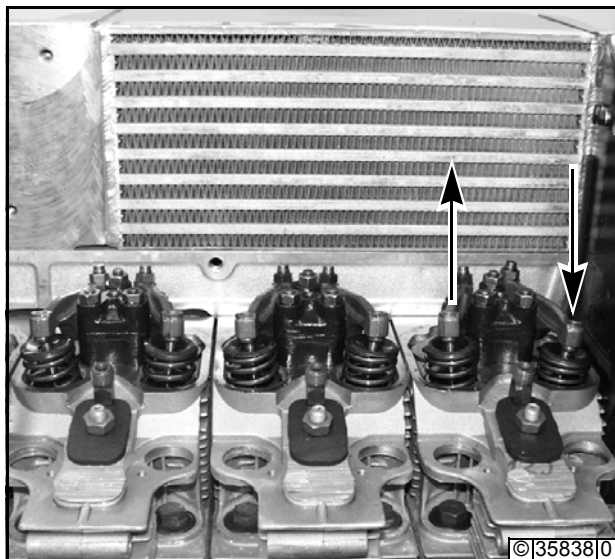
**Disassembly**

- Remove cooling air guide sheets.



- Undo pipe.
- Remove cylinder head covers.





#### Adjust valve clearance

- Crank engine until valves of cyl. no.1 overlap.



#### Note

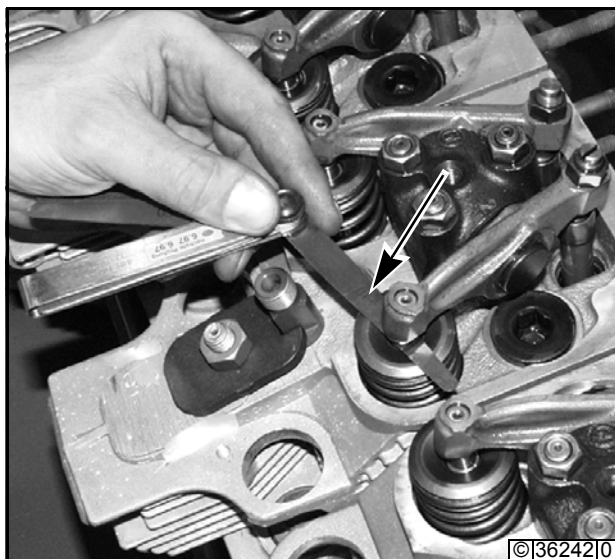
Valve overlap means:

Exhaust valve is still not closed, inlet valve about to open. The two push rods cannot be turned in this position.

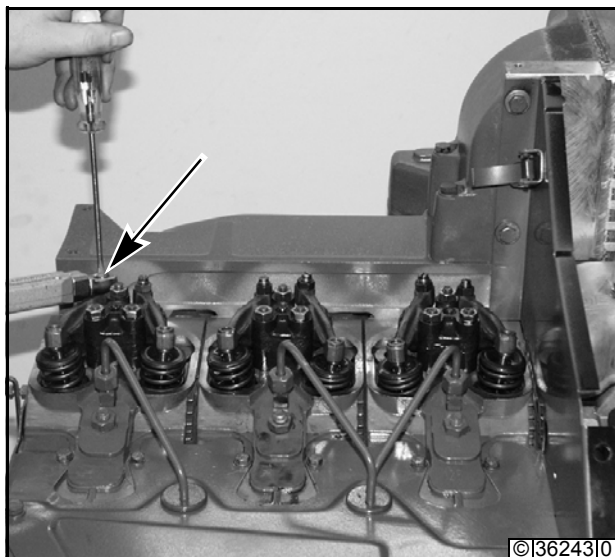


#### Note

The injection lines are removed here for a clearer overview.



- Check valve clearance on relevant cylinder with feeler gauge, adjust if necessary.



- Tighten lock nut.



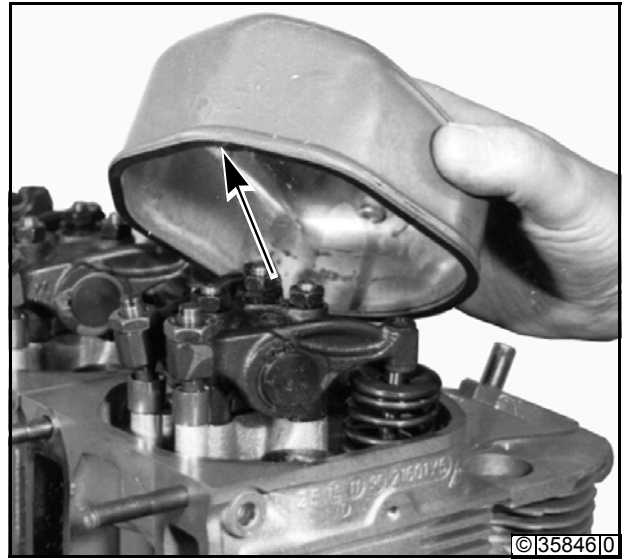
- Recheck the adjustment with feeler gauge.



**Assembly****Note**

Graphitized gasket surface points towards the cylinder head. Adhere new gasket onto cylinder head cover using **DEUTZ KL 8** adhesive.

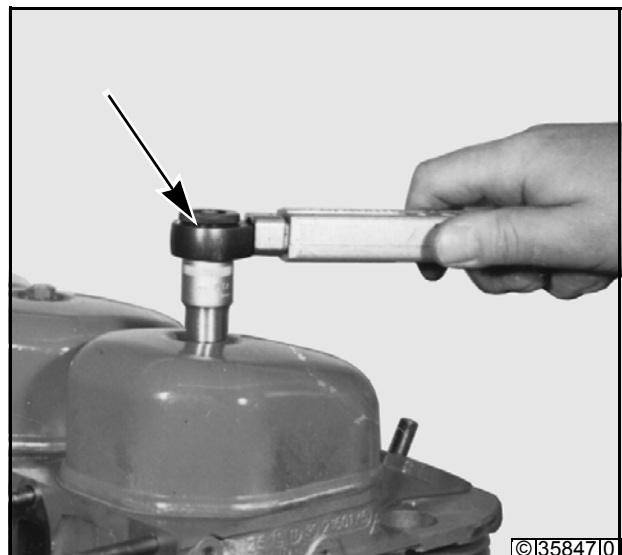
- Reinstall cylinder head covers.

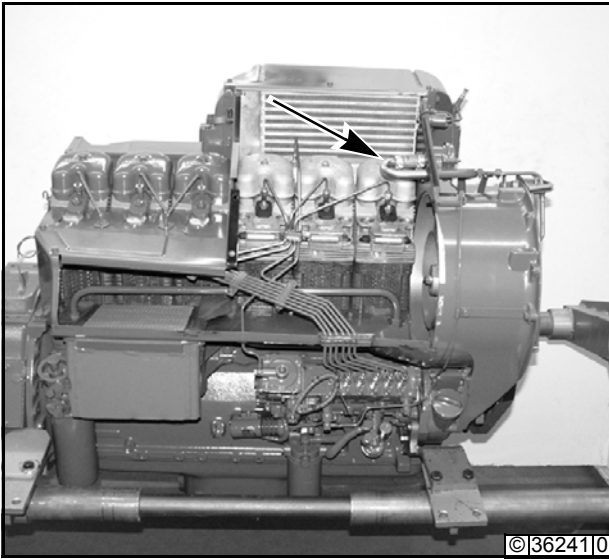


- Screw in bolts with washer and new sealing ring.

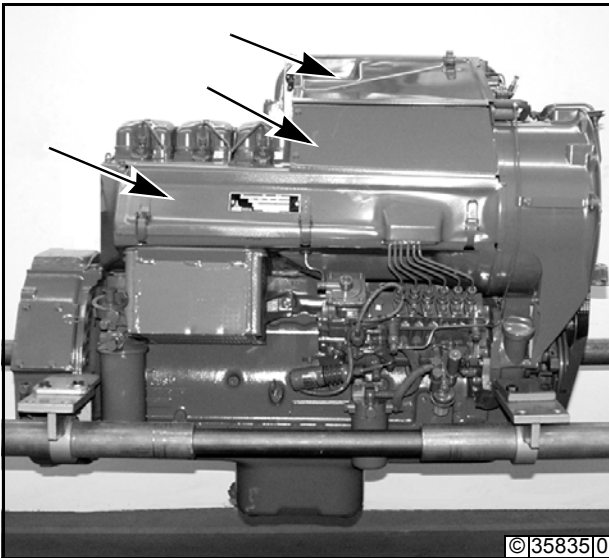


- Tighten bolts with the appropriate torque.





- Fasten pipe.



- Remount cooling air guide sheets.

## Remove and refit rocker arm and rocker arm bracket



### Tools

- Commercial tools



### References

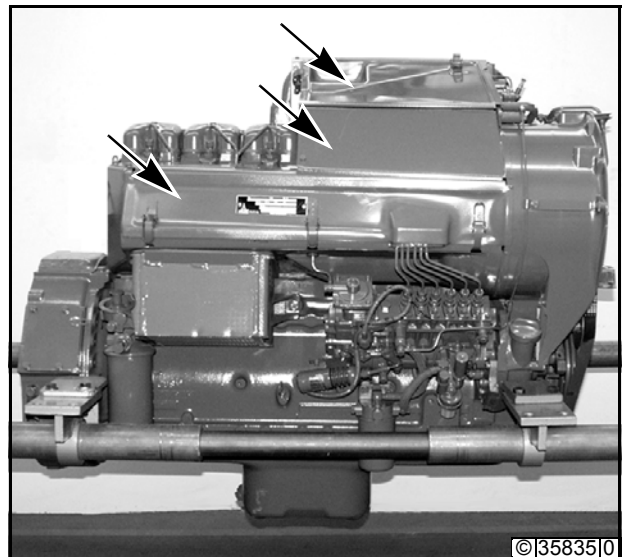
- W 1-1-1

### Auxiliary aids

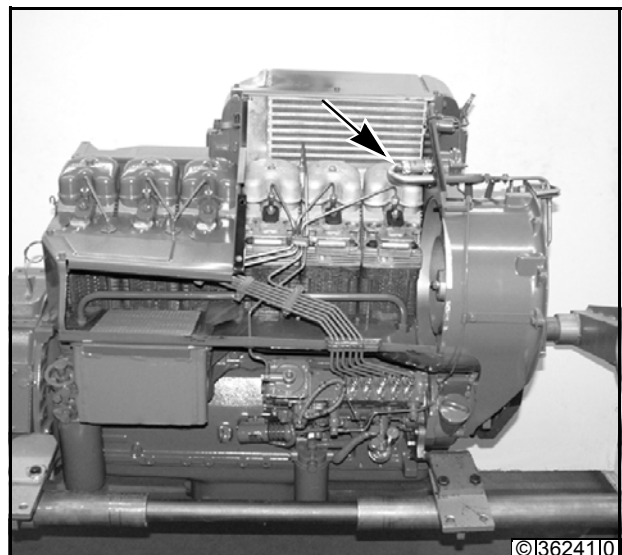
- DEUTZ KL 8

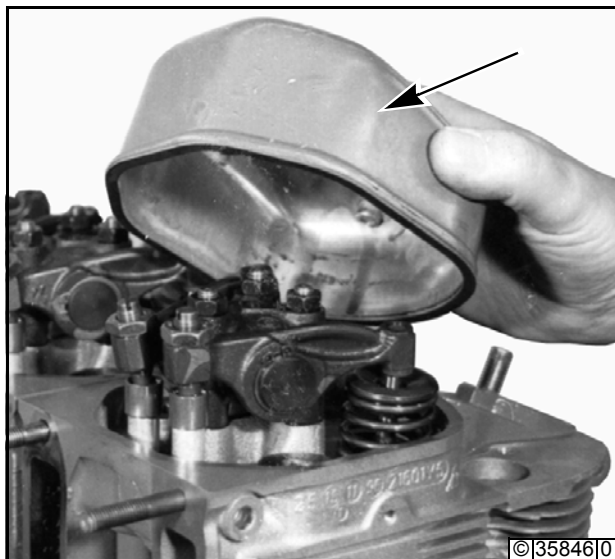
### Remove rocker arm and rocker arm bracket

- Remove cooling air guide sheets.

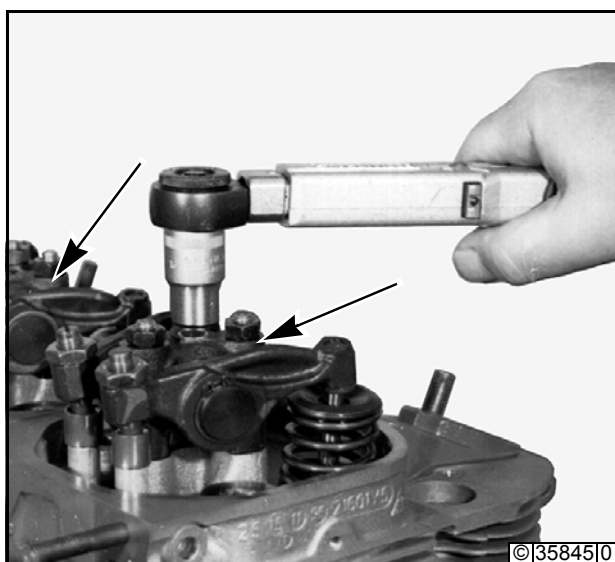


- Remove pipe.

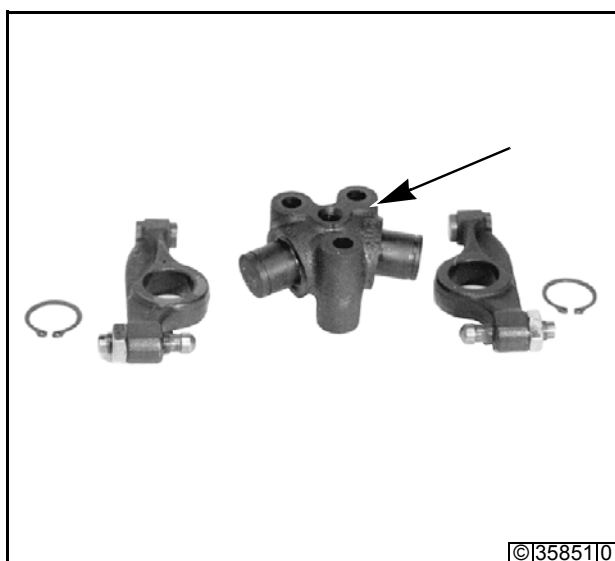




- Remove cylinder head covers.



- Dismount rocker arm bracket.



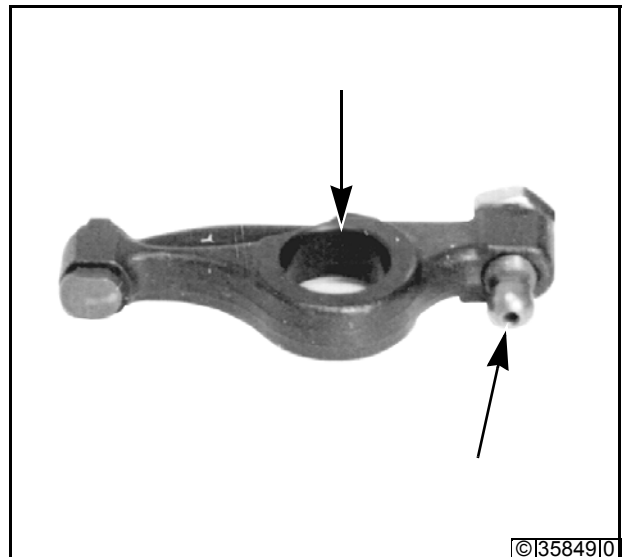
- Dismantle rocker arm bracket.



- Check bearing journal, adjusting screw, rocker arm contact surfaces and bore for wear, renew if necessary.

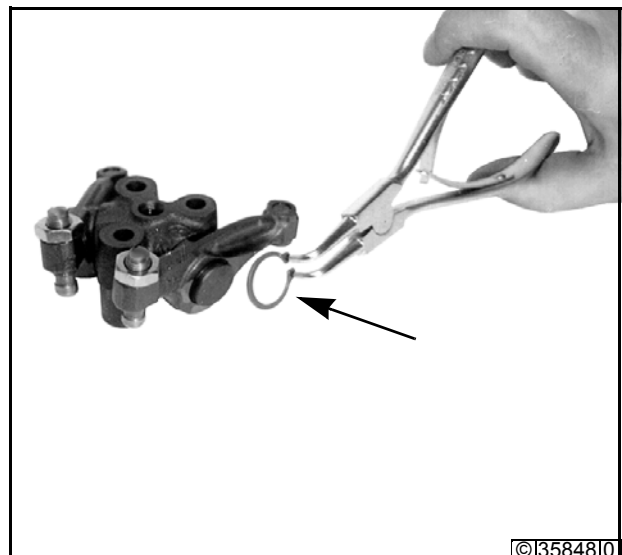


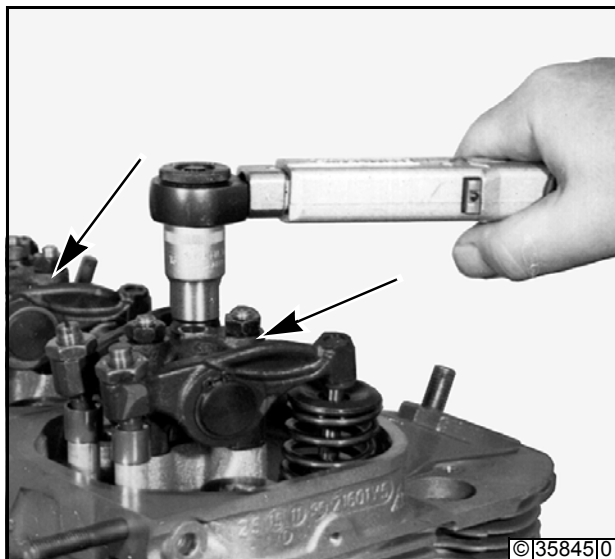
- Check oil duct for free passage.



#### Assemble rocker arm and rocker arm bracket

- Assemble rocker arm bracket. Fit circlips.





- Reinstall rocker arm brackets. Tighten hex nuts.



- Check valve clearance, adjust if necessary  
- see work card **W 1-1-1**.



**Note**

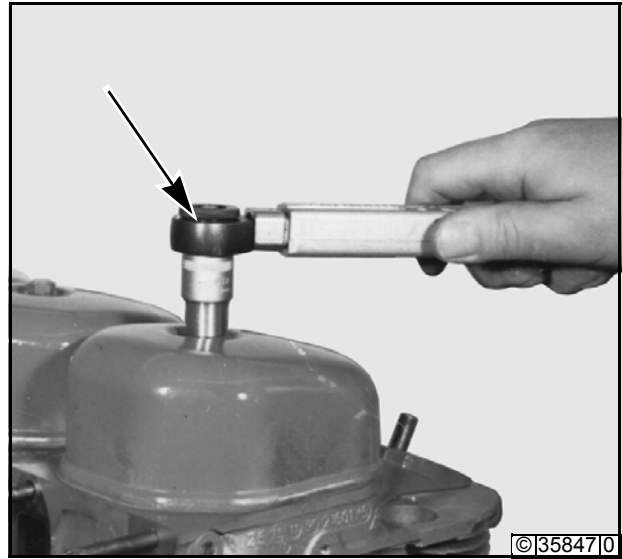
Graphitized surface of the new gasket  
(arrow) points towards the cylinder head.

- Adhere new gasket onto cylinder head cover  
using **DEUTZ KL 8** adhesive. Move cylinder head  
covers into position.

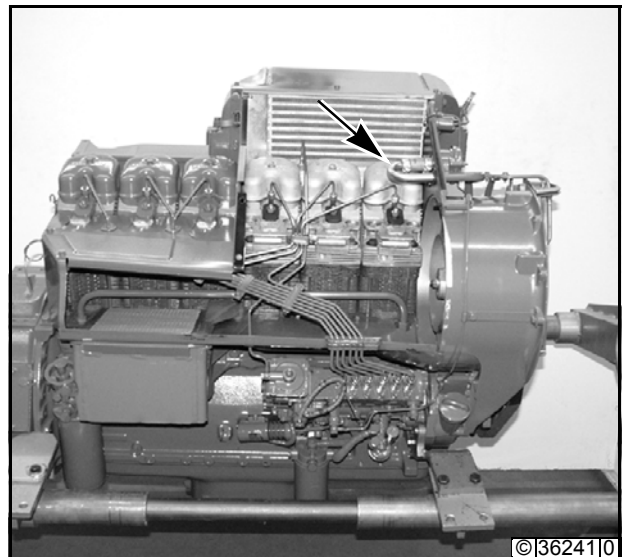


- Remount cylinder head covers with disc and new  
sealing ring.

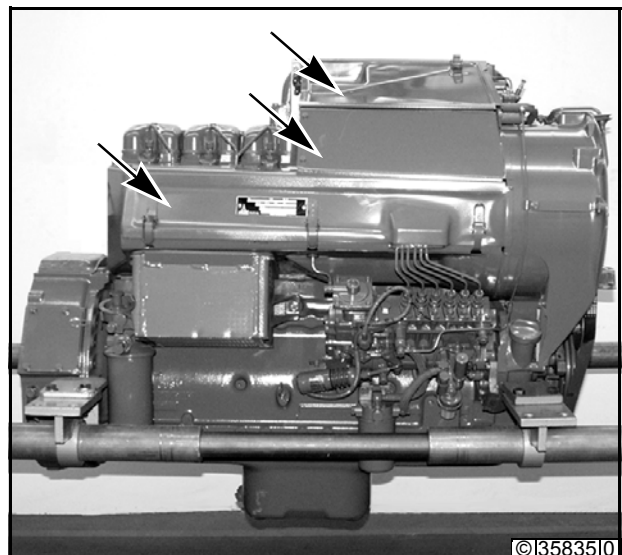
- Tighten bolts with appropriate torque.



- Fasten pipe.



- Remount cooling air guide sheets.



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## Checking the top dead center



### Tools

- Special tools
- Dial gauge \_\_\_\_\_ 100 400
- Adjusting device \_\_\_\_\_ 100 640
- Pointer \_\_\_\_\_ 100 740



### Auxiliary aids

- DEUTZ KL 8

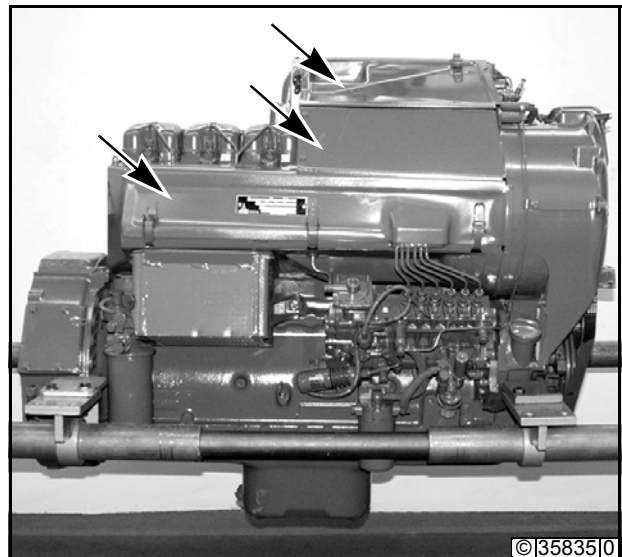


### Note

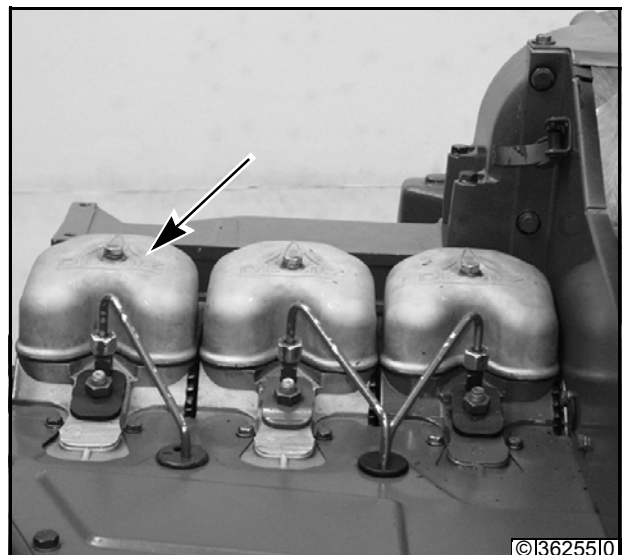
- After replacement of the V-belt pulley, the "Top Dead Center" must be redetermined.
- The V-belt is removed in this work process.

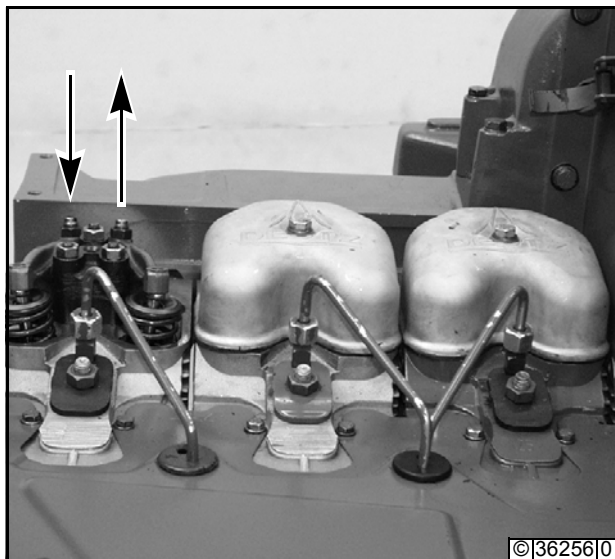
## Check the top dead center

- Remove cooling air guide sheets.



- Remove cylinder head covers from cylinder no.1.





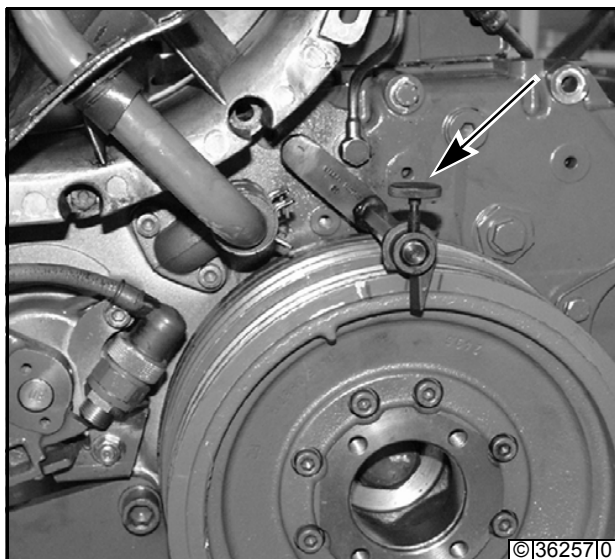
- Crank engine until valves of cylinder no.1 overlap.



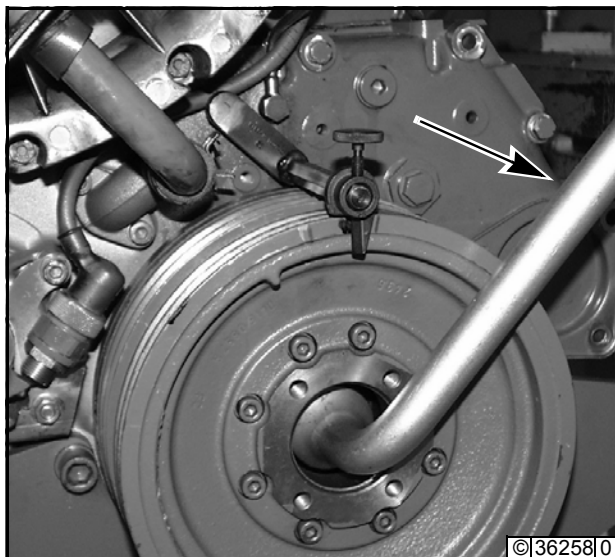
**Note**

Valve overlap means:

Exhaust valve is still not closed, inlet valve about to open. The two push rods cannot be turned in this position.



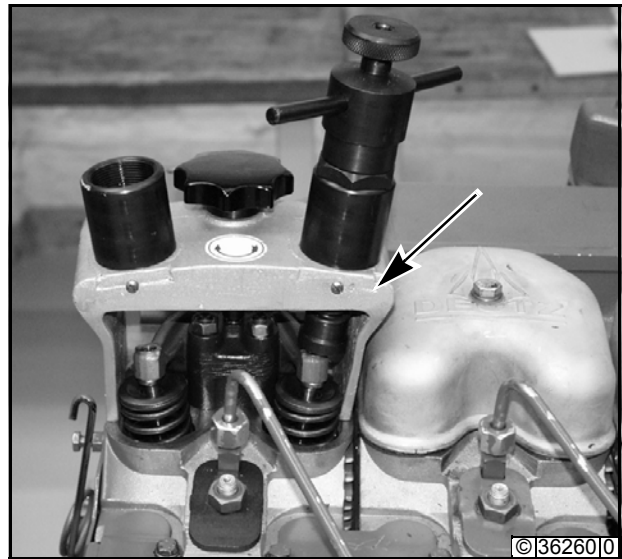
- Fit pointer.



- Turn crankshaft approx. 180° further in direction of engine rotation.



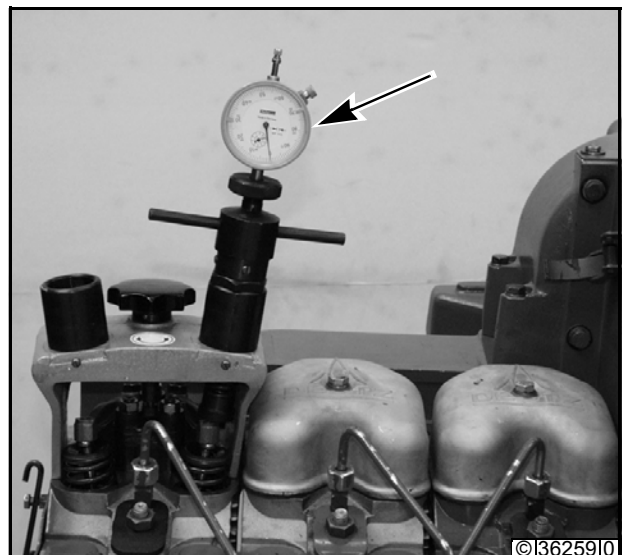
- Fit adjusting device.

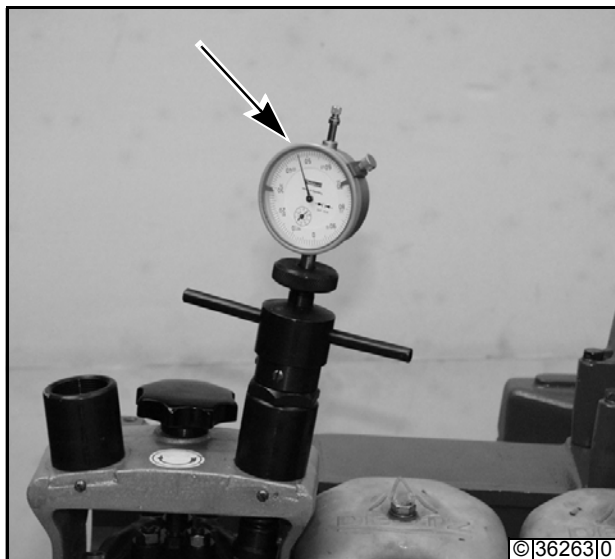


- Using pressure screw of adjusting device, press down one rocker arm by approx. 5 mm.



- Insert dial gauge with preload.





- Turn crankshaft in direction of engine rotation until pointer of dial gauge begins to move.

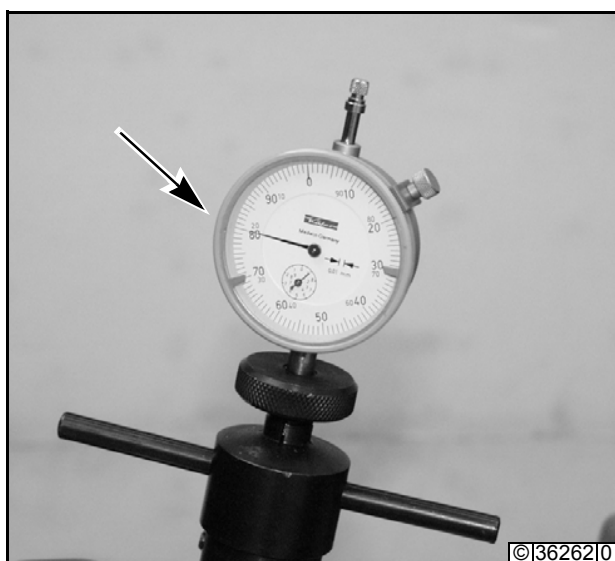


**Note**

The piston coming upward thereby moves the pressed-down valve.



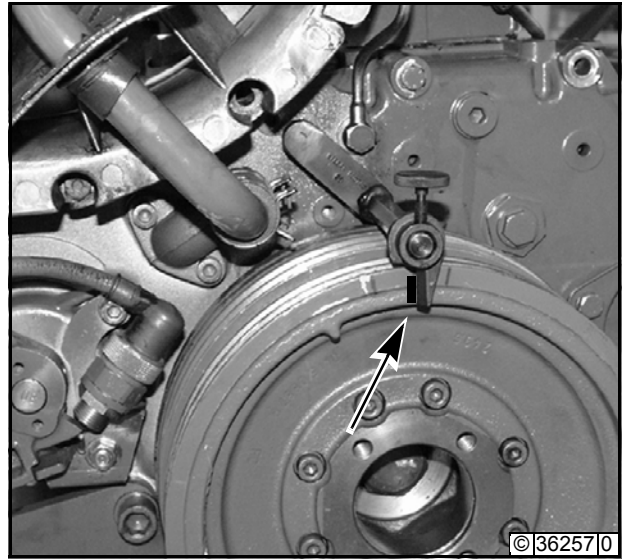
- Slowly turn crankshaft further until the dial gauge pointer has just reached its reversal point. Set dial gauge to zero.



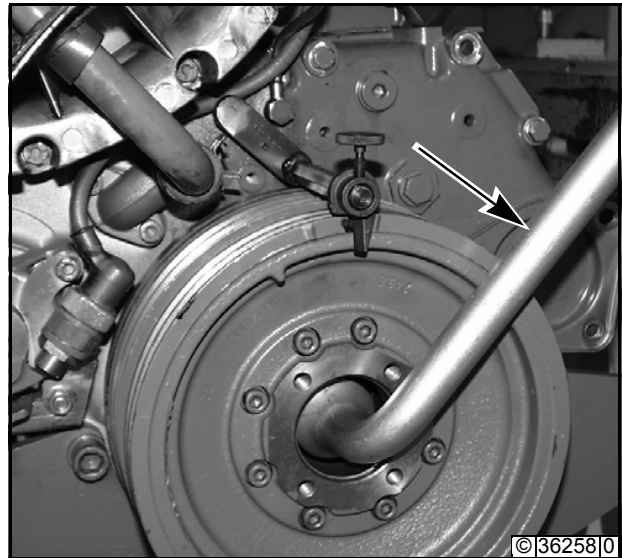
- Turn crankshaft 90° in opposite direction of engine rotation and then in direction of engine rotation until 20 graduations before the zero position are reached on the dial gauge.



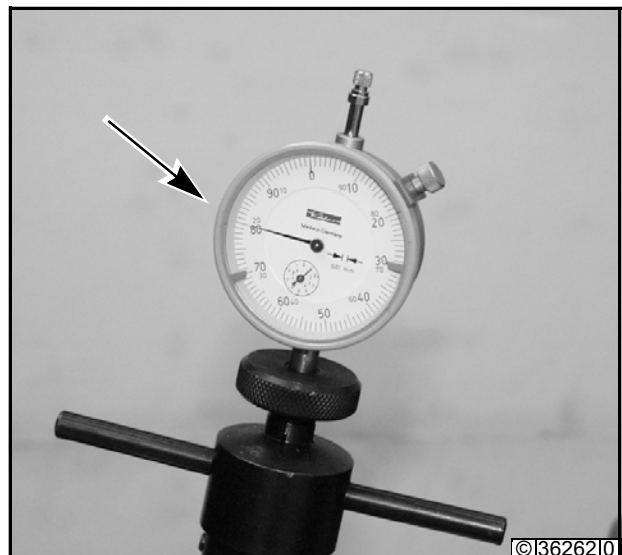
- Make the first marking in this position opposite the pointer.

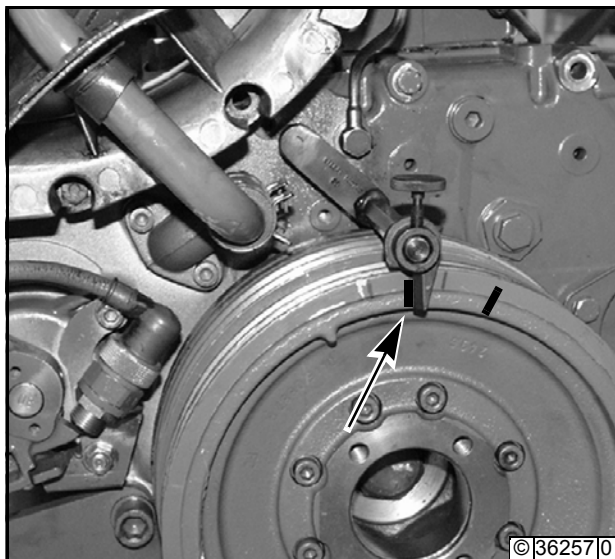


- Turn crankshaft further by approx. 90° in direction of engine rotation.

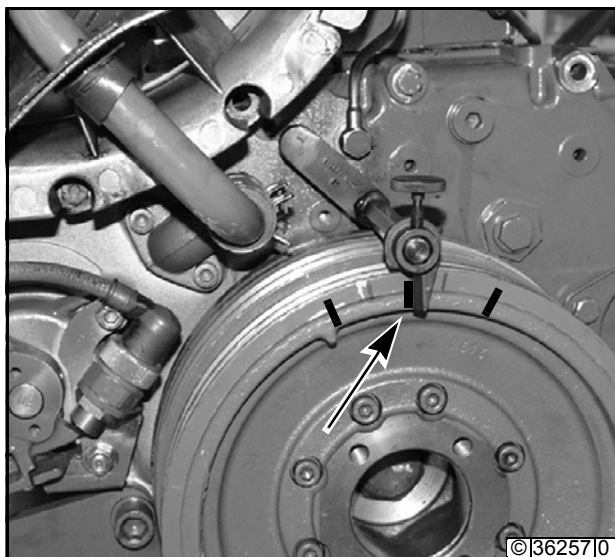


- Turn crankshaft in opposite direction of engine rotation until 20 graduations before the zero position are reached on the dial gauge.

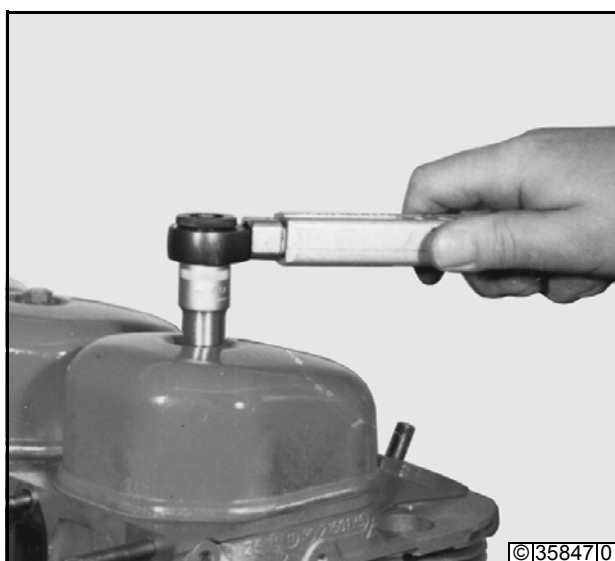




- Make the second marking opposite the pointer.



- Mark the mid-point between the two markings.  
This mid-way mark is the TDC marking.



- Dismount TDC adjusting device.



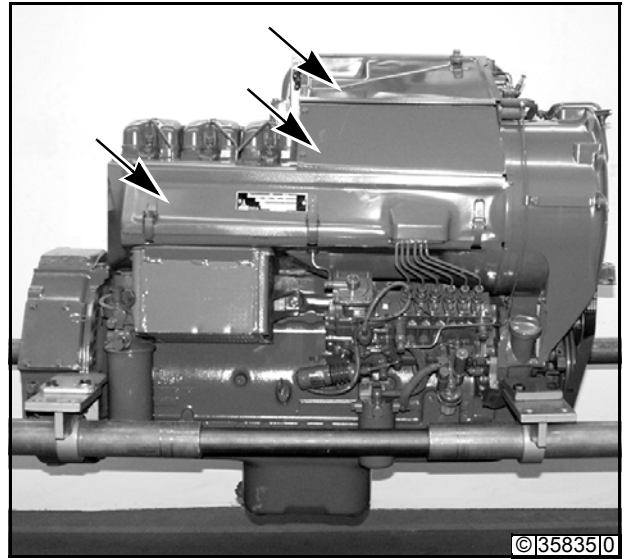
**Note**

Graphitized gasket surface points towards the cylinder head. Adhere new gasket onto cylinder head cover using **DEUTZ KL 8** adhesive.

- Move cylinder head covers into position.
- Screw in bolts with washer and new sealing ring and tighten.



- Remount cooling air guide sheets.



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**Removing and refitting the cylinder head****Tools**

- Commercial tools
- Torque wrench
- Special tools
- Socket wrench for cylinder head bolts \_\_\_\_\_ 120 040
- Spring compressor \_\_\_\_\_ 125 310

**References**

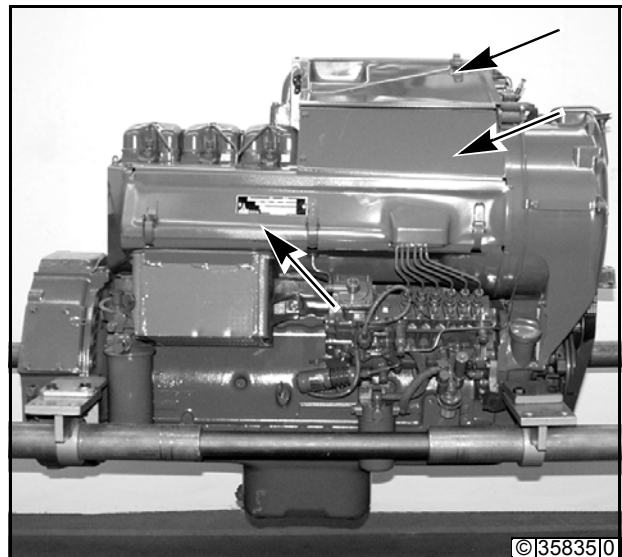
- W 1-2-2
- W 6-1-5
- W 7-3-1
- W 7-7-1

**Auxiliary aids**

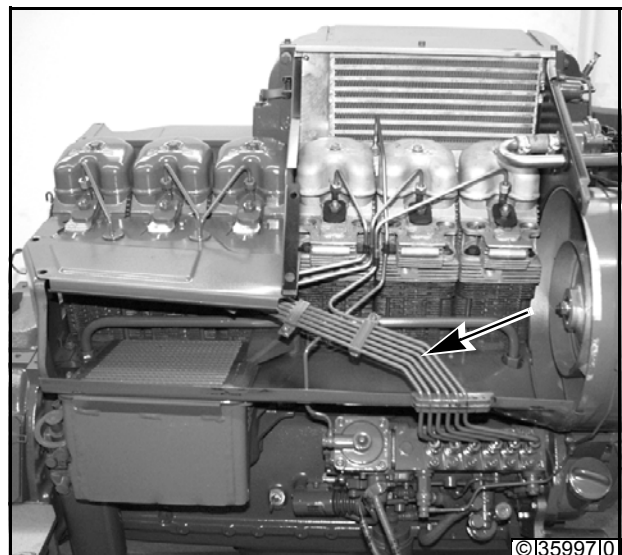
- DEUTZ KL 8

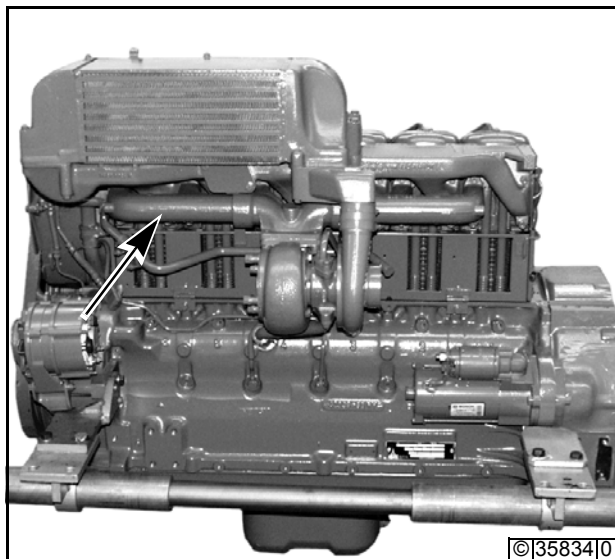
**Remove cylinder head**

- Remove cooling air guide sheets.

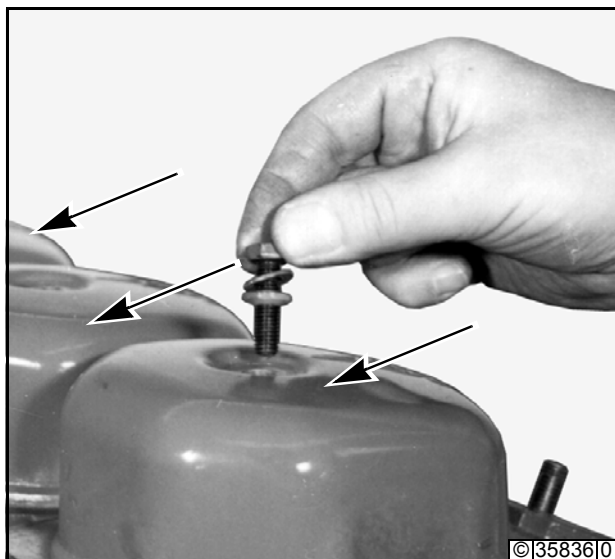


- Remove injection lines.

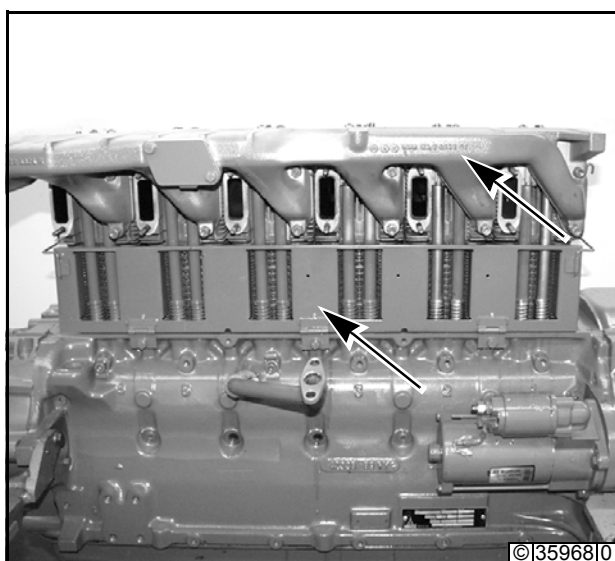




- Remove exhaust manifold and turbocharger  
- see work card **W 6-1-5**.



- Remove cylinder head covers.



- Remove air intake manifold and shield.



- Remove rocker arm and rocker arm bracket.



**Note**

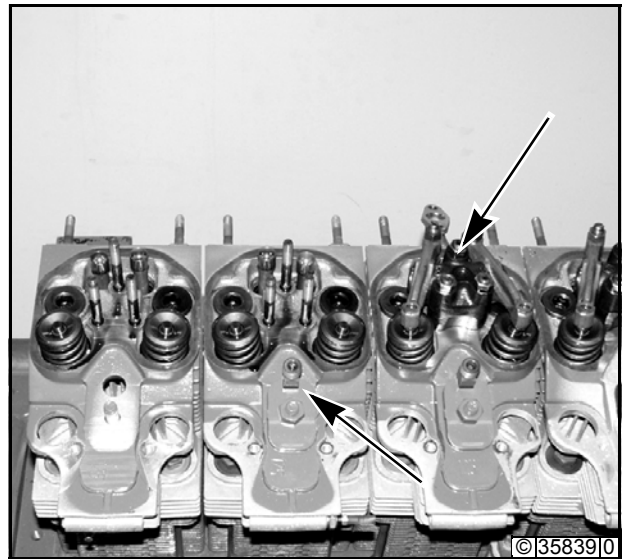
Lay the components down in their sequence of assembly.

- Remove injectors

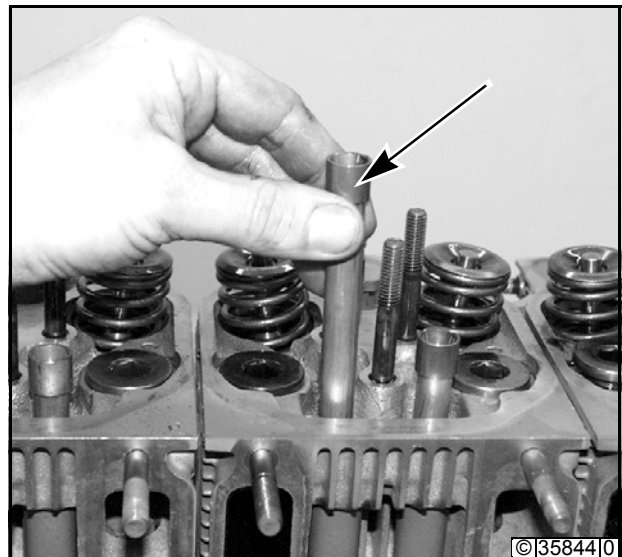


**Note**

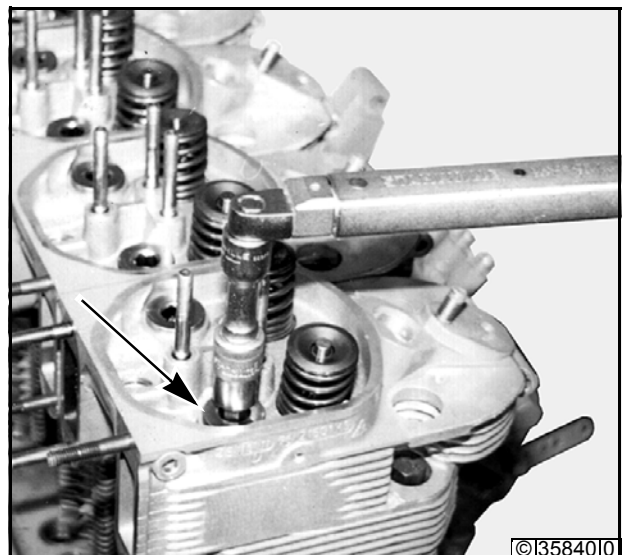
If the injectors are jammed  
- see work card **W 7-7-1**.

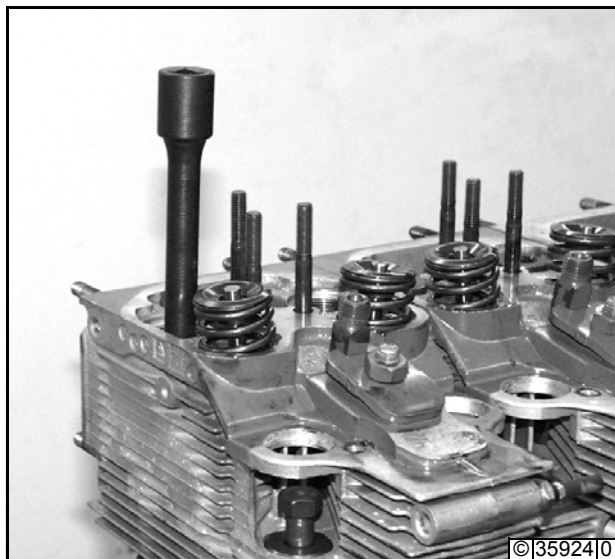


- Take out push rods.

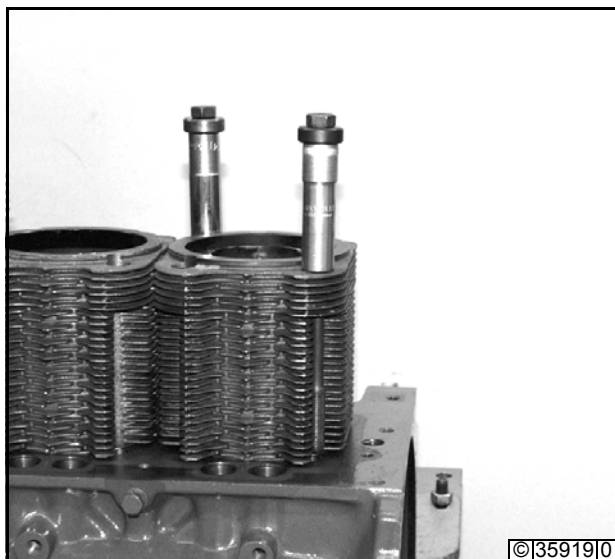


- Remove blanking plugs.





- Remove cylinder head bolts with a socket wrench.
- Remove cylinder heads and shims and label them.
- Remove cover tube with compression springs, caps and sealing rings.



- Secure cylinder so that it cannot fall.

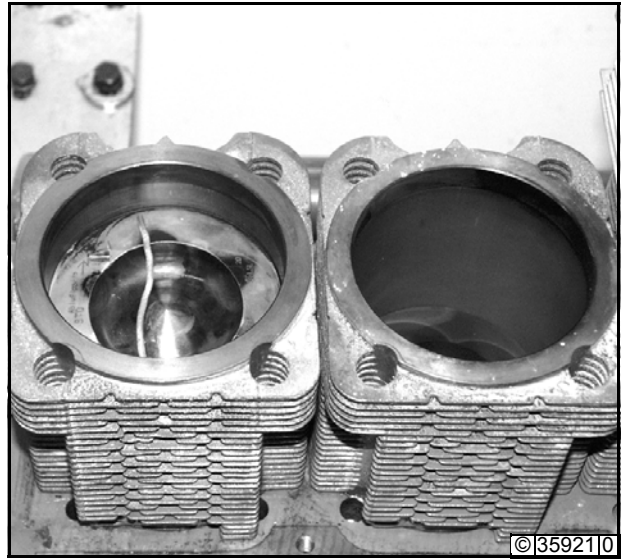


**Refit cylinder head**

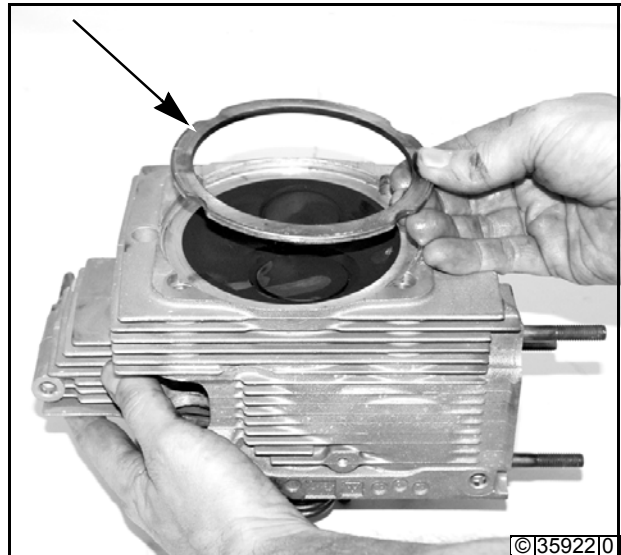
- Align cylinders.



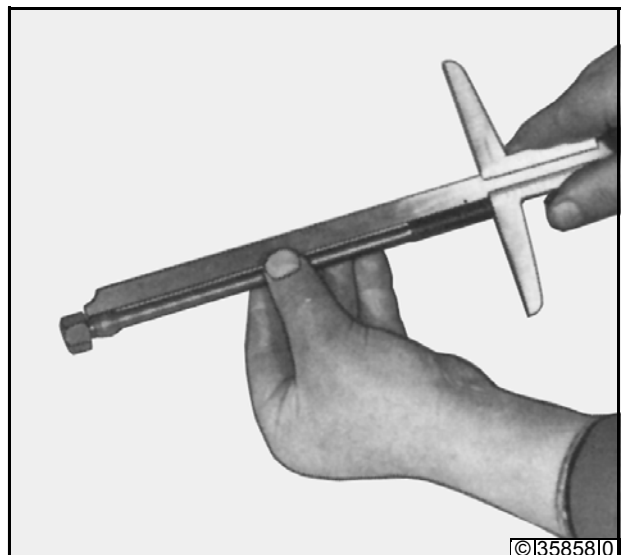
- Measure the piston crown clearance  
-see work card **W 1-4-9**.

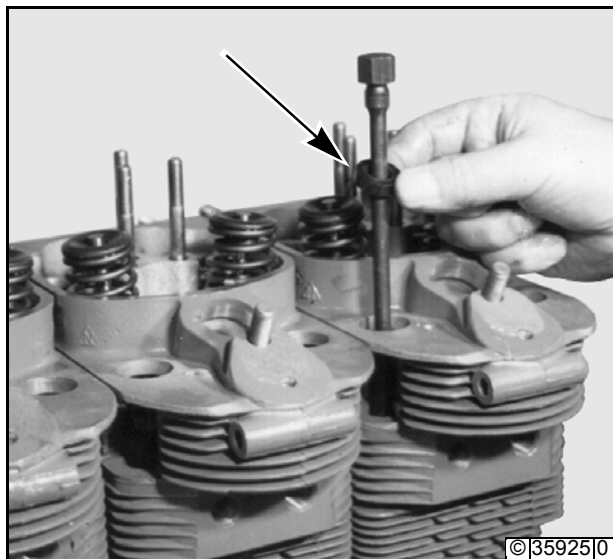


- Position the shim in accordance with the measured piston clearance and align. Position the cylinder heads in accordance with the labelling.



- Measure cylinder head bolt.



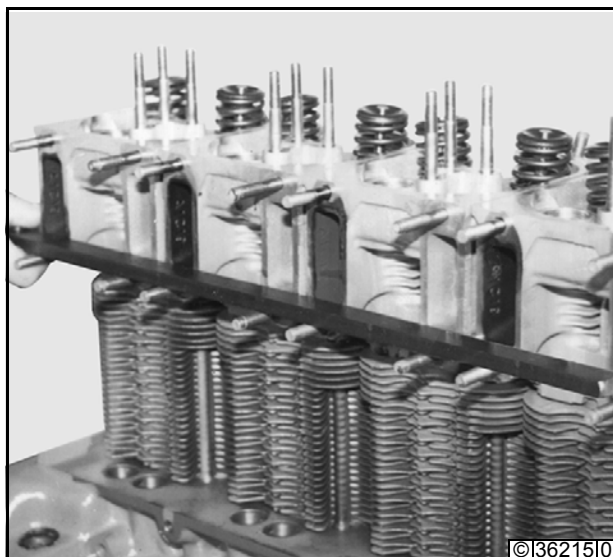


- Insert cylinder head bolts.

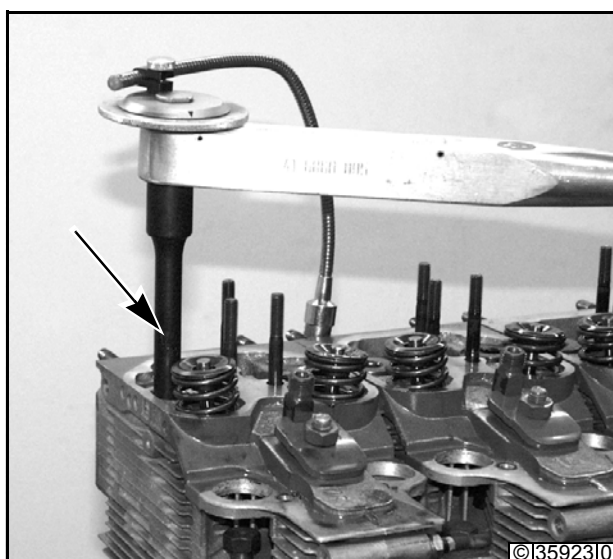


**Note**

The cylinder head bolts are provided with washers at the injector end. The washers are pressed into the cylinder head at the exhaust end.



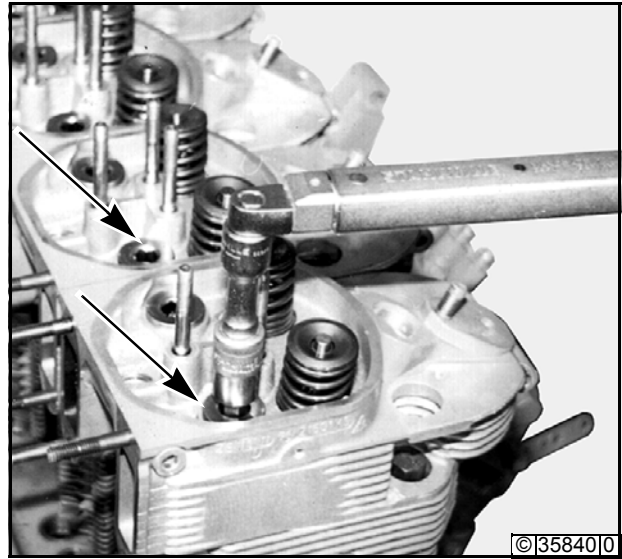
- Align cylinder heads.



- Tighten cylinder head bolts crosswise with a socket wrench.

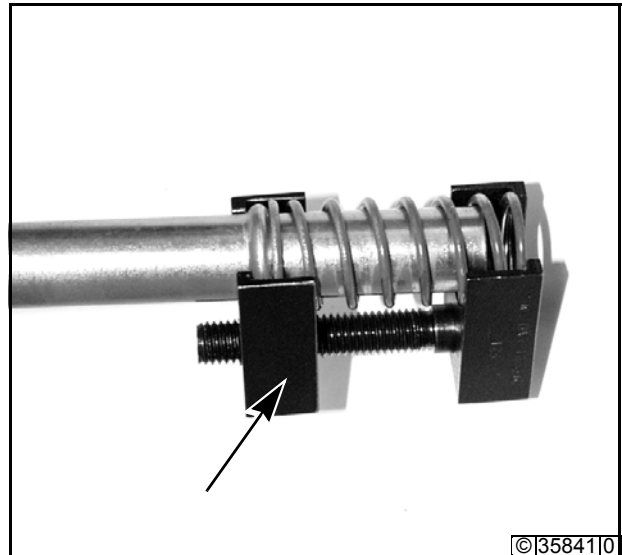


- Screw in blanking plugs and tighten.



©35840|0

- Slide compression spring onto the cover tube and tension with spring compressor.



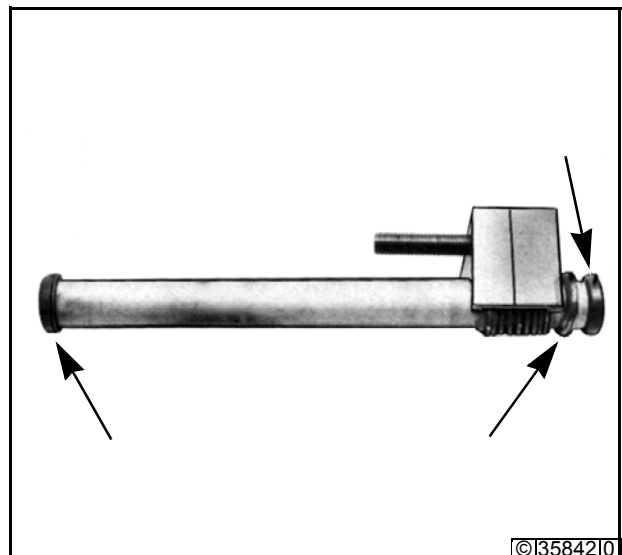
©35841|0

- Assemble cover tube with cap and new sealing rings.

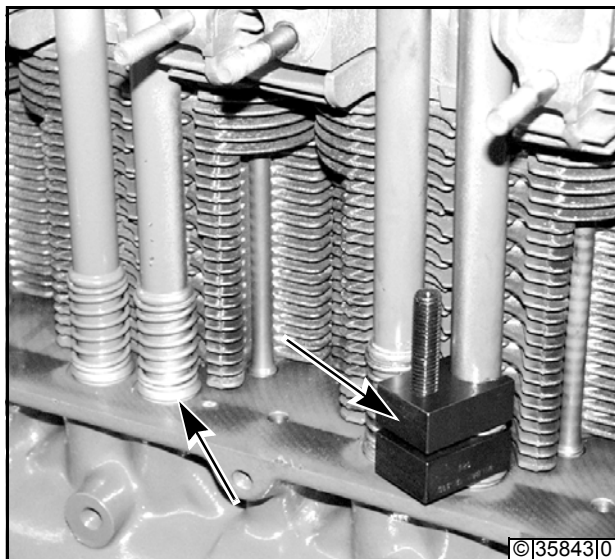


**Note**

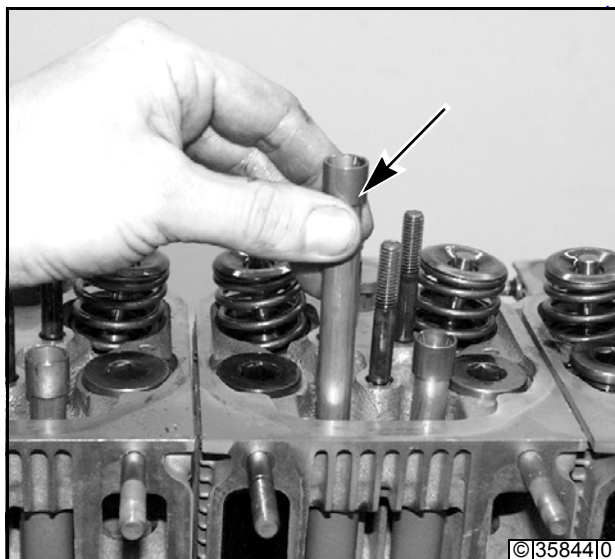
The rounded side of the sealing ring points upwards.



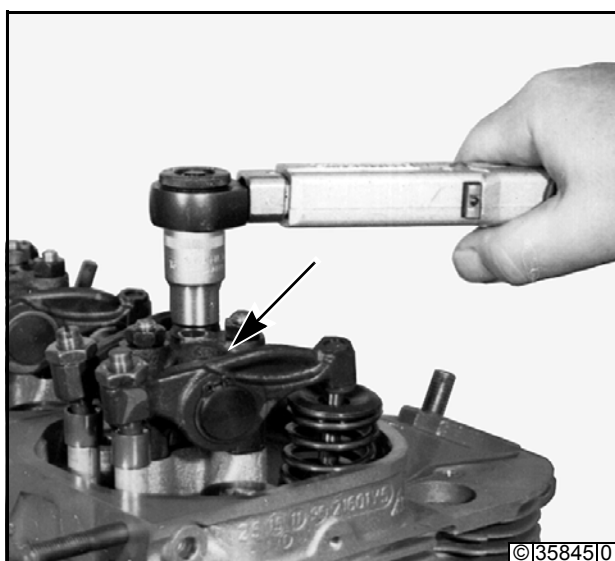
©35842|0



- Slide cover tube first into the crankcase and then into the cylinder head. Pull out spring compressor.



- Insert push rods.



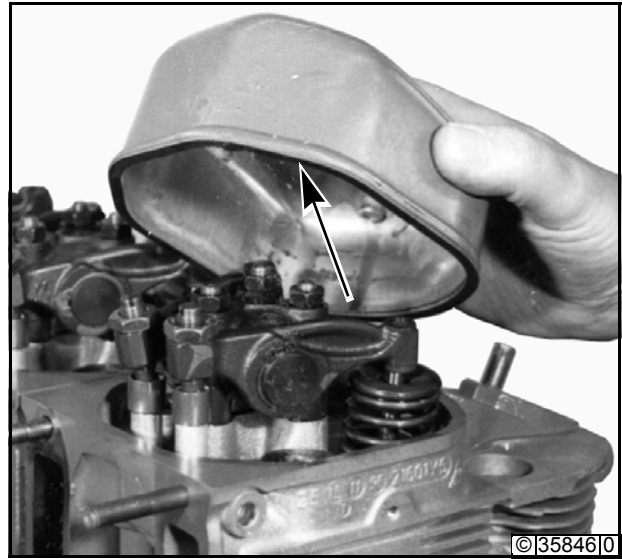
- Refit rocker arm and rocker arm bracket  
- see work card **W 1-2-2**.
- Tighten hex nuts.



**Note**

Graphitized surface of the gasket points towards the cylinder head.

- Adhere new gasket onto cylinder head cover using **DEUTZ KL 8** adhesive.



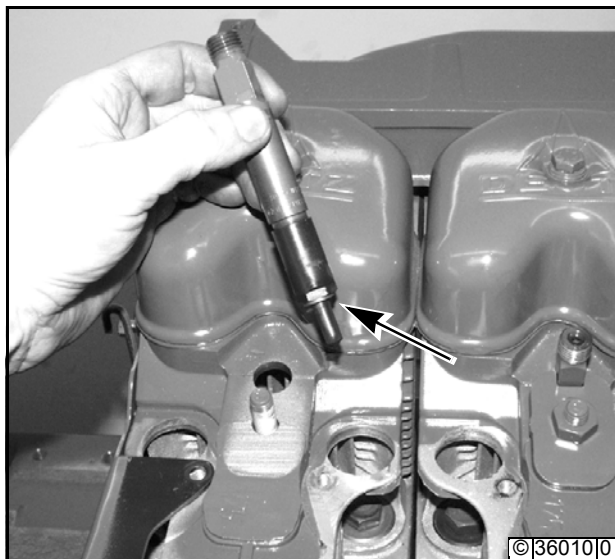
- Screw in bolts with washer and new gasket.



- Tighten bolts with appropriate torque.



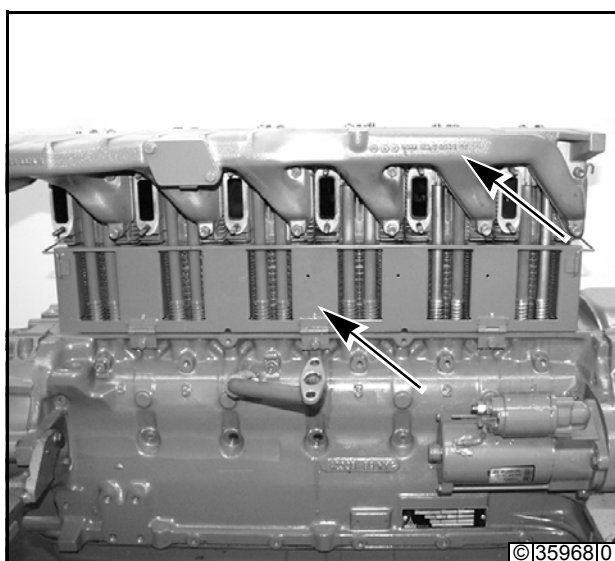




- Adhere new sealing ring using a little grease.
- Insert injectors.

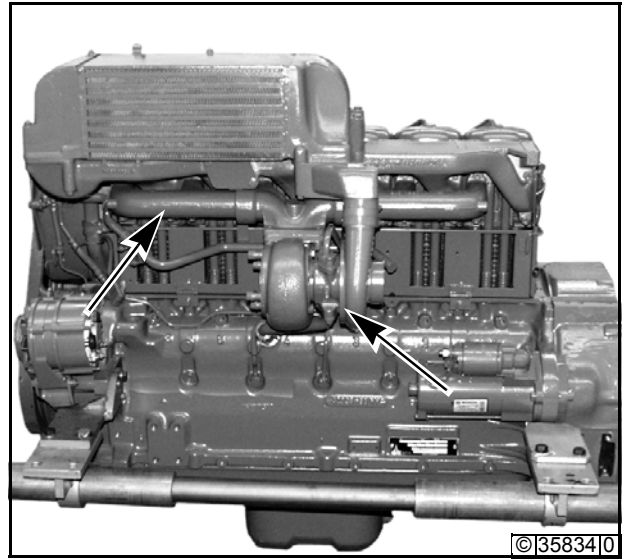


- Place on clamping pad. Tighten hex nuts with appropriate torque.

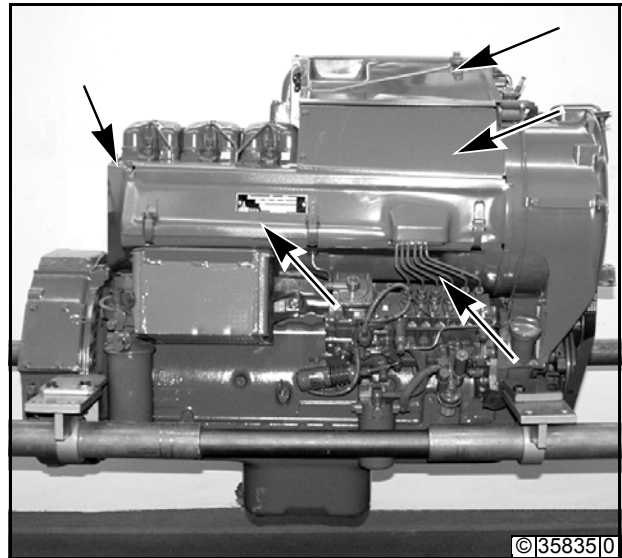


- Refit shield and air intake manifold.

- Remount exhaust manifold and turbocharger  
- see work card **W 6-1-5**.



- Renew injection lines  
- see work card **W 7-3-1**.
- Refit cooling air guide sheets.



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**Reworking the cylinder head sealing surface****Tools**

- Commercial tools
- Lathe
- Depth calliper gauge
- Special tools
- Clamping fixture \_\_\_\_\_ 125 500

**Caution**

The repaired cylinder heads must be labelled as follows:

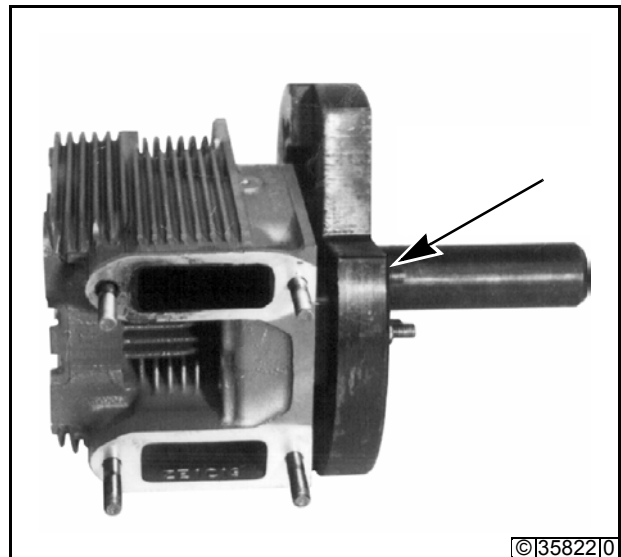
- Repair date (manufacturing date)  
according to work standard H0246 part 2

**References**

- W 1-5-1

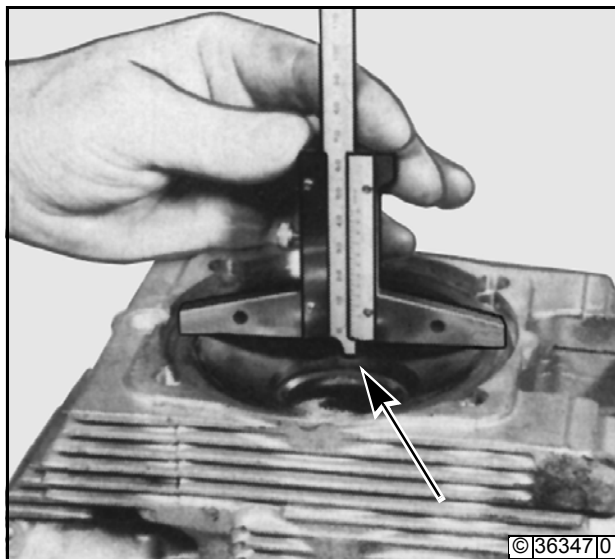
**Disassembly**

- Remove cylinder head and valves  
- see work card **W 1-5-1**.
- Clean cylinder head and inspect visually for damage.
- Mount cylinder head onto clamping fixture.



- Take up clamping fixture in lathe. Rework cylinder head sealing surface.





- Gauge recess of cylinder head bottom relative to cylinder head sealing surface without shim.



- Refit valves and cylinder head  
- see work card **W 1-5-1**.

## Measuring the piston crown clearance



### Tools

- Commercial tools
- External micrometer
- Special tools
- Cylinder head wrench \_\_\_\_\_ 120 040

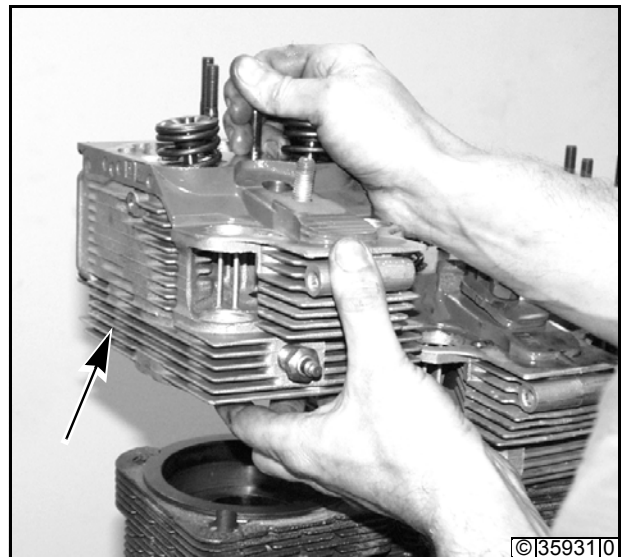


### References

- W 1-4-4

### Remove cylinder head

- Remove cylinder head and align cylinders  
- see work card **W 1-4-4**.



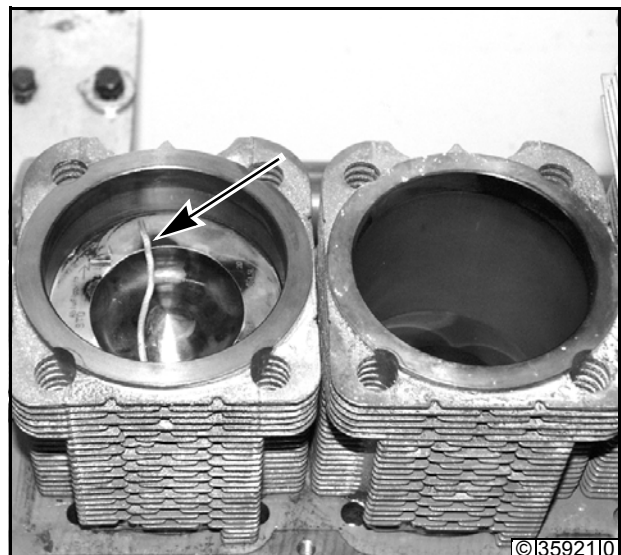
### Measure piston crown clearance

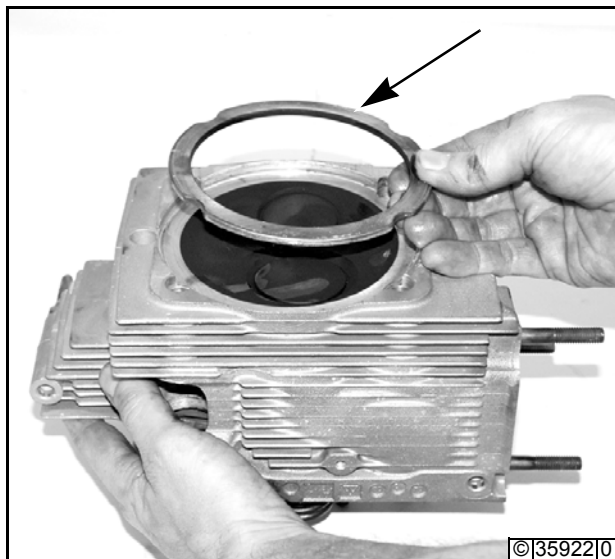
- Place a 2 mm lead wire on each piston in  
transverse direction to the engine axis.



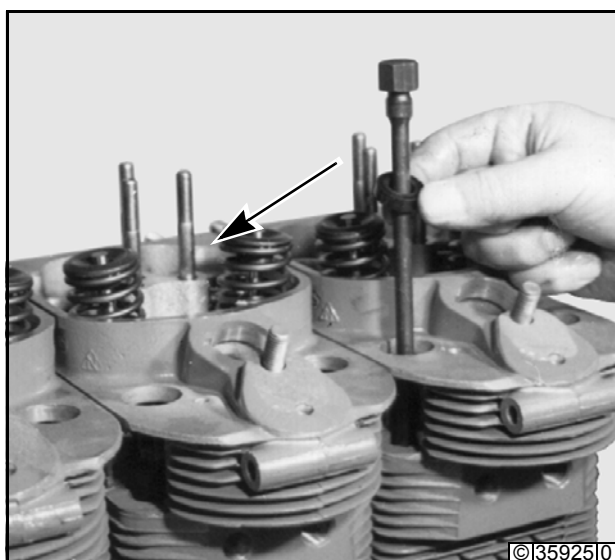
### Note

Before the cylinder heads are positioned all  
pistons must be below the TDC.





- Place on and align shim.



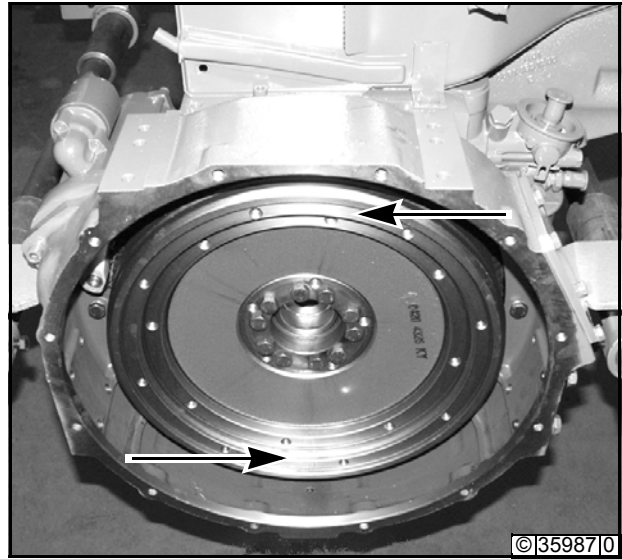
- Place on cylinder heads.
- The cylinder head bolts are provided with washers at the injector end.
- The washers are pressed into the cylinder head at the exhaust end.
- Lightly oil cylinder head bolts and insert.



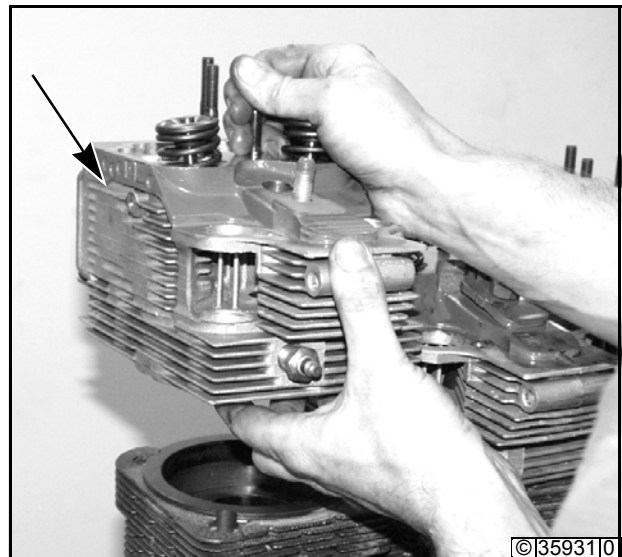
- Tighten cylinder head bolts crosswise with cylinder head wrench for measuring piston crown clearance.



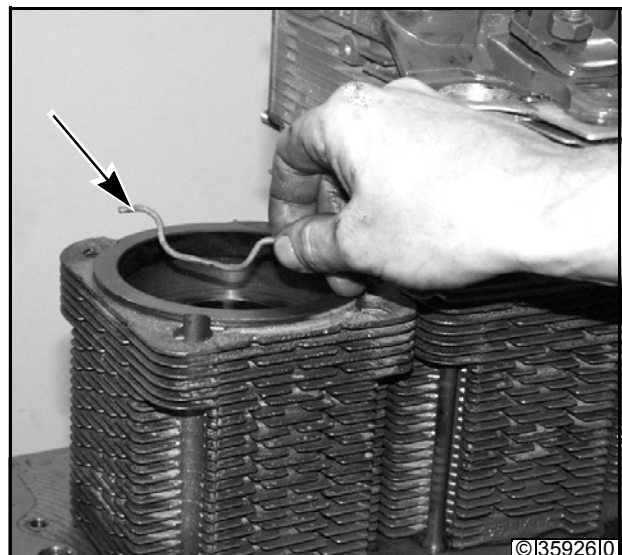
- Crank engine through 360°.



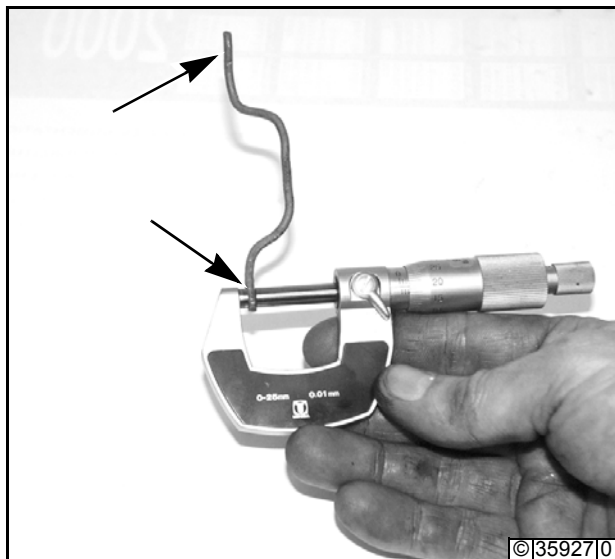
- Mark cylinder heads according to cylinder unit and remove together with cylinder head bolts.



- Remove squashed lead wires from the piston crowns.





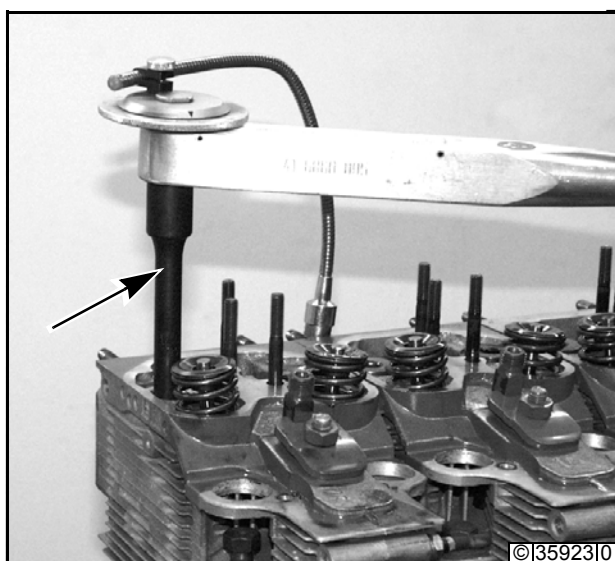


- Measure lead wire at the thinnest point on both ends. The mean value is the piston crown clearance.



**Note**

Use a shim of appropriate thickness for correcting piston crown clearance. Shims are available in 3.0 - 3.9 mm thickness at increments of 0.05 mm



**Refit cylinder head**

- Refit cylinder head and align cylinders - see work card **W 1-4-4**.
- Tighten cylinder head bolts crosswise with cylinder head wrench.



## Removing and refitting the valves



### Tools

- Special tools
- Clamping stand \_\_\_\_\_ 120 900
- Clamping plate \_\_\_\_\_ 120 910
- Valve spring compressor \_\_\_\_\_ 121 120

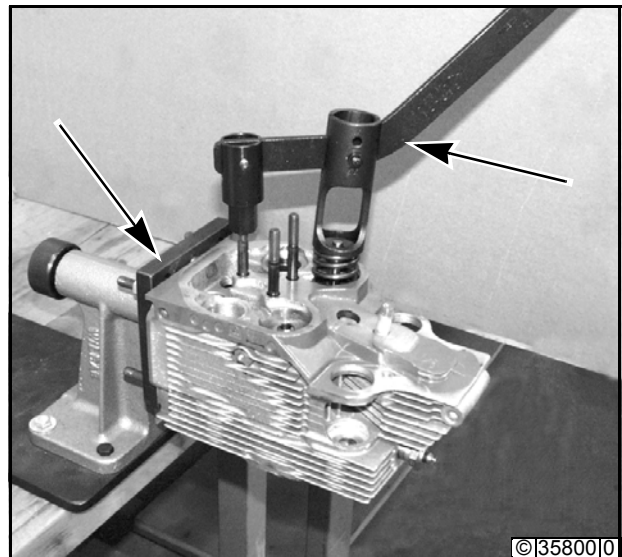


### References

- W 1-4-4

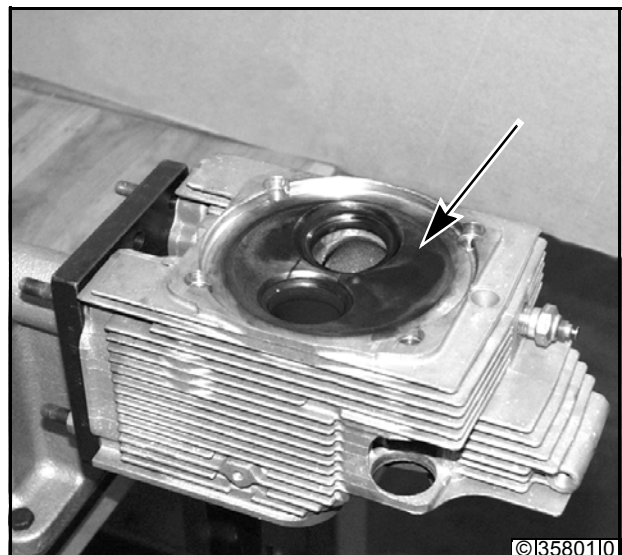
### Remove valves

- Dismount cylinder head
  - see work card **W 1-4-4**.
- Mount cylinder head on clamping plate and clamping stand.
- Remove valves with valve spring compressor.



### Check cylinder head and valves

- Clean cylinder head, monitor and inspect visually for damage.





**Refit values**

- Place on washer.

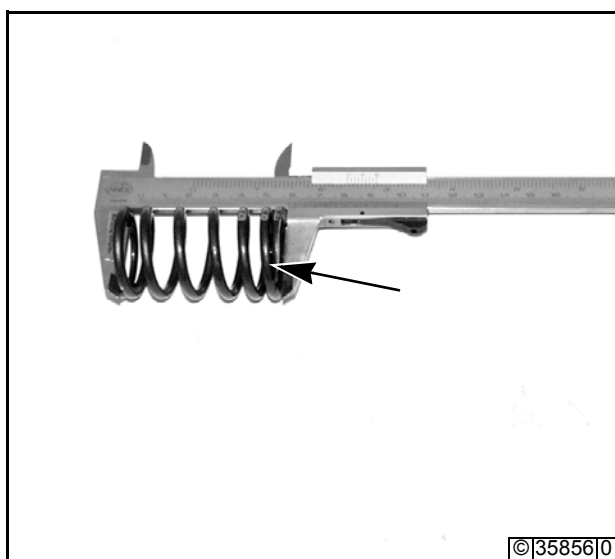


- Oil valve stem and insert valve.



**Note**

Support valve.



- Gauge length of valve spring. Replace if necessary.





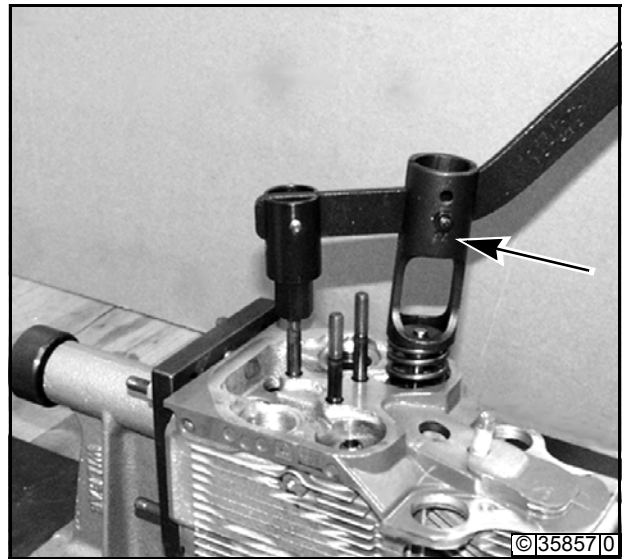
- Assemble cylinder head:  
Install valve spring, valve spring cap and valve  
collet.



**Note**

Position valve spring so that the **closer  
windings** face the cylinder head.

- Mount cylinder head  
- see work card **W 1-4-4**.



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## Checking the valves



### Tools

- Commercial tools
- External micrometer
- Calliper gauge



### References

- W 1-5-1



### Note

- All valves have been removed and cleaned.

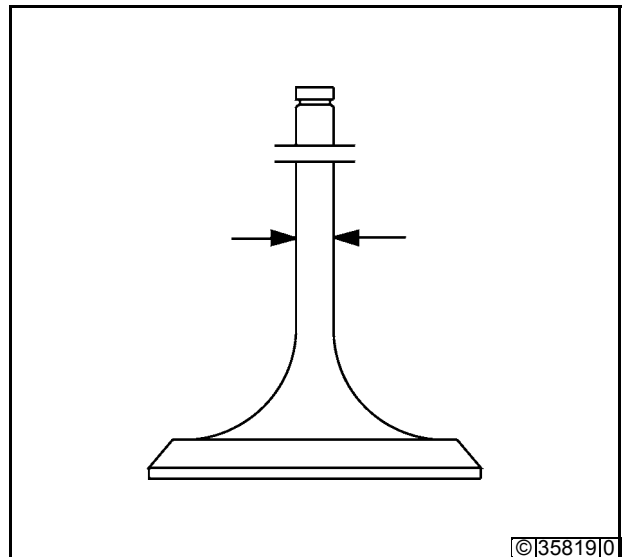
### Valve stem diameter

- Remove cylinder head and valves  
- see work card **W 1-5-1**.
- Gauge valve stem diameter with external micrometer.



### Note

- Replace the valve if the wear limit has been reached.



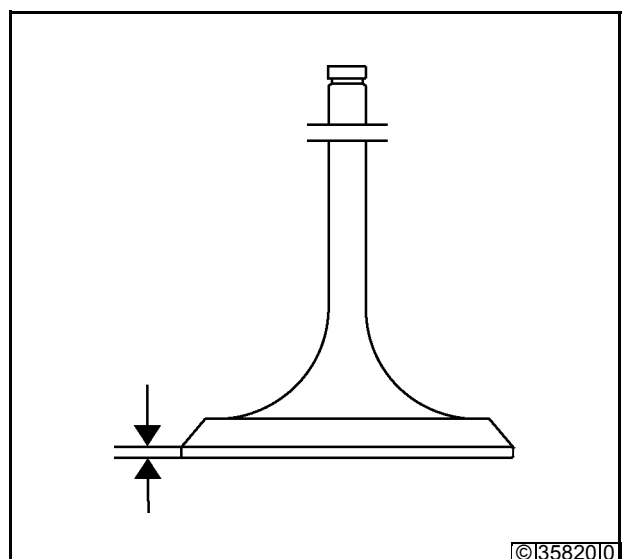
### Valve edge thickness

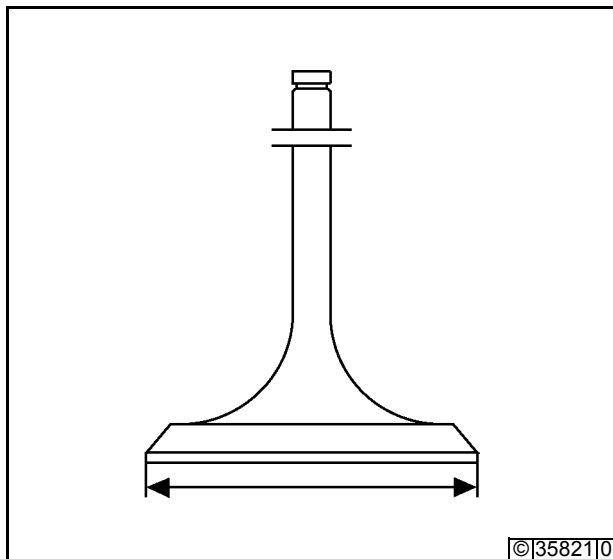
- Gauge valve edge thickness with a calliper gauge.



### Note

- Replace the valve if the wear limit has been reached.





**Valve disc diameter**

- Gauge valve disc diameter with a calliper gauge.



**Note**

Replace the valve if the wear limit has been reached.



## Removing and refitting the valve guide



### Tools

- Commercial tools
  - Limit plug gauge
  - Reamer
- Special tools
  - Dial gauge \_\_\_\_\_ 100 400
  - Clamping stand \_\_\_\_\_ 120 900
  - Clamping plate \_\_\_\_\_ 120 910
  - Assembly mandrel \_\_\_\_\_ 123 310



### Caution

The repaired cylinder heads must be labelled as follows:

- Repair date (manufacturing date) according to works standard H0246 part 2



### References

- W 1-4-4
- W 1-5-1

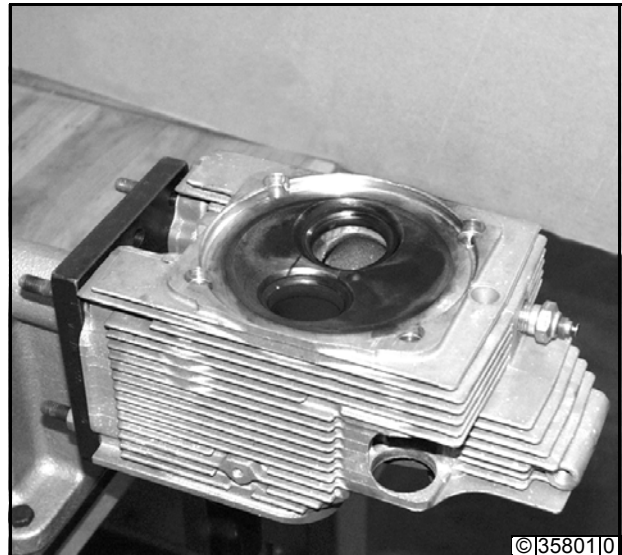


### Note

- Valve guides have been checked for wear.

### Remove valve guide

- Dismount cylinder head
  - see work card **W 1-4-4**.
- Remove inlet and exhaust valves
  - see work card **W 1-5-1**.
- Heat cylinder head in heating furnace to 220° C.

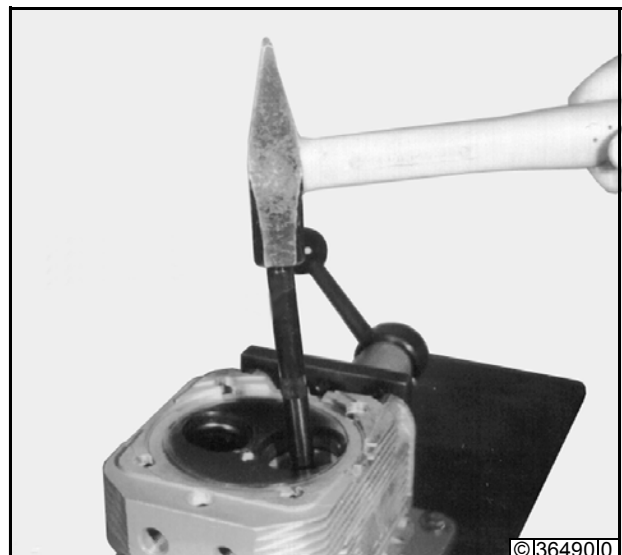


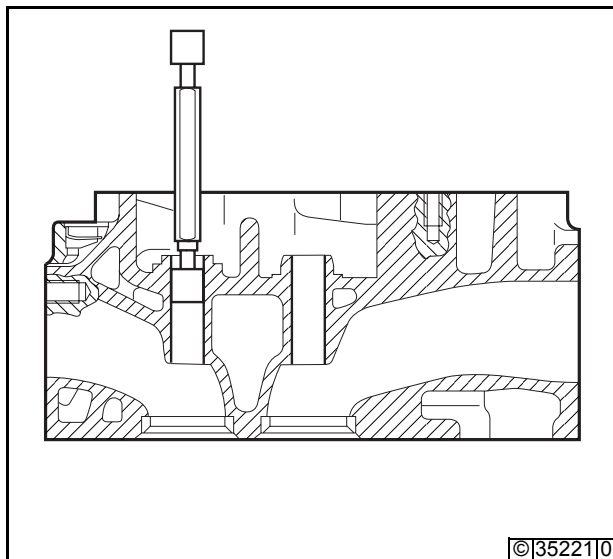
- Carefully force valve guides out of the bottom of the cylinder head with assembly mandrel.



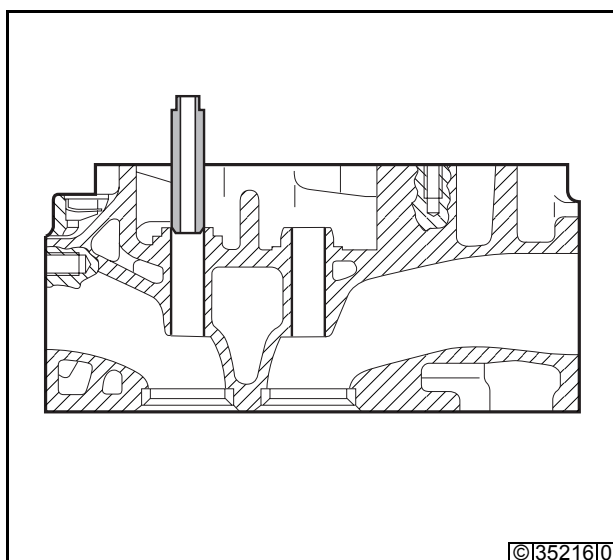
### Note

Outsize valve guides may already be available from production. Change the valve guides after heating the cylinder head once to 220° C.



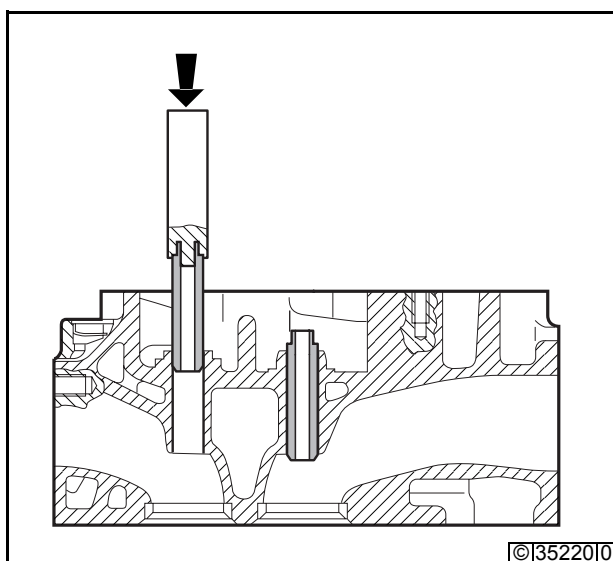


- Before dismantling original parts, the take-up geometry of the valve guides must be gauged with a limit plug gauge and must be within tolerances.



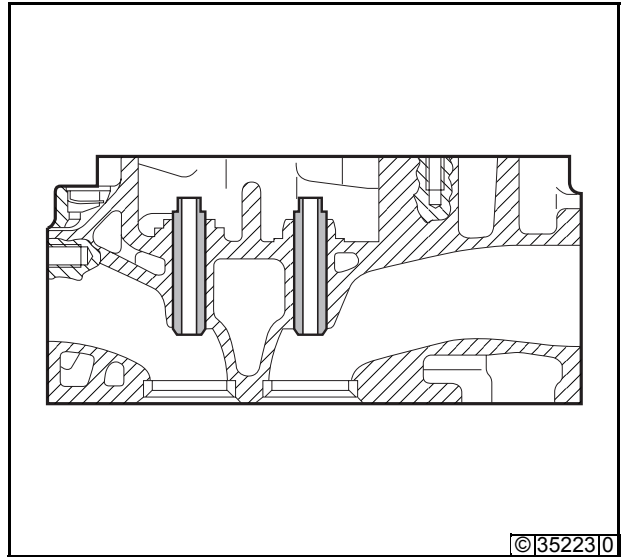
#### Install valve guides

- Insert new valve guide from above. The inclined side of the valve guide points towards the cylinder head.



- Carefully force the valve guide in using the assembly mandrel, from top to bottom, until the stop is reached (flush).

- Check the valve guides for damage, if necessary ream the valve guide with a reamer.



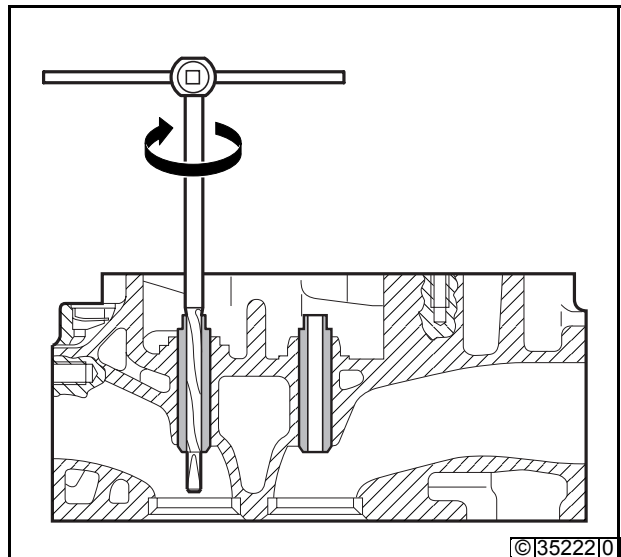
- Ream valve guide from the top of the cylinder head.



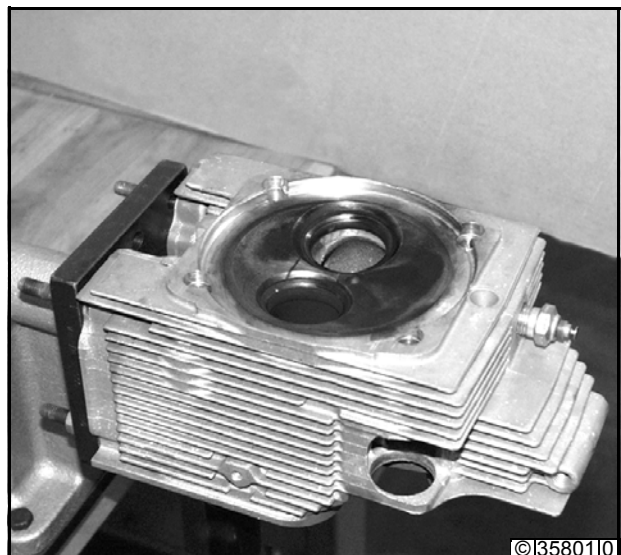
#### Note

Reamers have a left-hand twist and must be turned clockwise both in and out. Never turn reamers backwards (anticlockwise). The shavings created as material is removed would otherwise become jammed and destroy the cutters.

In order to avoid chatter marks, turn the reamer into the valve guide using light, even pressure.



- Refit inlet and exhaust valves  
- see work card **W 1-5-1**.
- Mount cylinder head  
- see work card **W 1-4-4**.



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## Checking the valve guide



### Tools

- Commercial tools
- Magnetic measuring stand
- Special tools
- Dial gauge \_\_\_\_\_ 100 400
- Clamping stand \_\_\_\_\_ 120 900
- Clamping plate \_\_\_\_\_ 120 910



### References

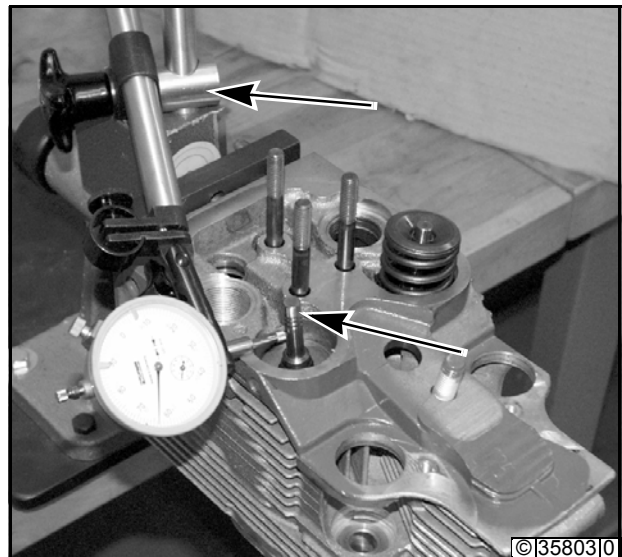
- W 1-5-1
- W 1-6-2



### Note

- The cylinder head has been dismantled.
- New valves are required for testing.

- Remove cylinder head and valves  
- see work card **W 1-5-1**.
- Visually inspect valve test for signs of wear.
- Fasten magnetic retainer to cylinder head.
- Insert new valve and adjust dial gauge.

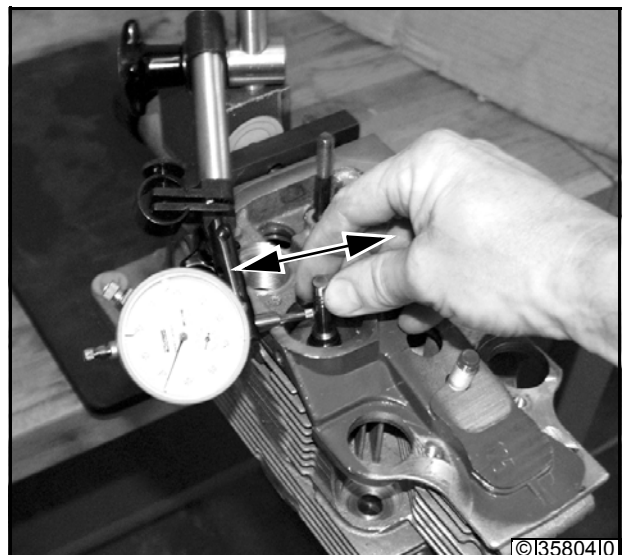


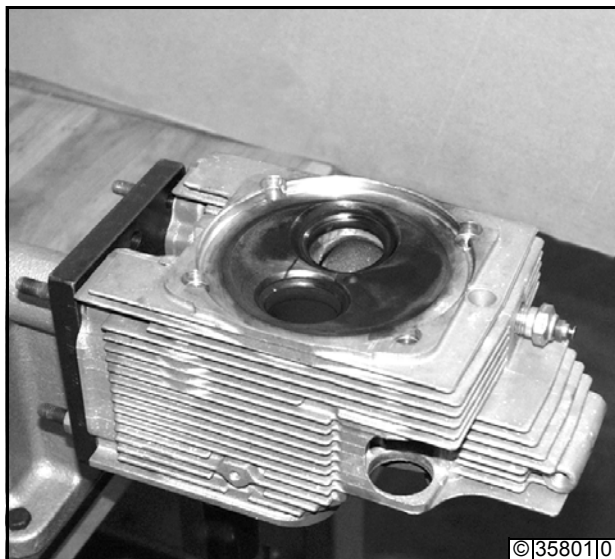
- Move the end of the valve stem back and forth in the direction of the arrow.



### Note

The complete rocker path must be taken into account.  
Replace valve guide if the limit of wear has been reached  
- see work card **W 1-6-2**.





- Install valves and remount cylinder head  
- see work card **W 1-5-1**.

## Removing, refitting and checking valve seat inserts



### Tools

- Commercial tools
  - Lathe
  - Valve reseating tool
- Special tools
 

Clamping arbor _____	122 450
Drill jig _____	122 460
Pilot pin with drill-jig bushes _____	122 461
Hard metal special milling cutter _____	122 463
Assembly mandrel exhaust _____	123 950
Assembly mandrel inlet _____	123 960
Clamping fixture _____	125 500



### Caution

The repaired cylinder heads must be labelled as follows:

- Repair date (manufacturing date) according to works standard H0246 part 2



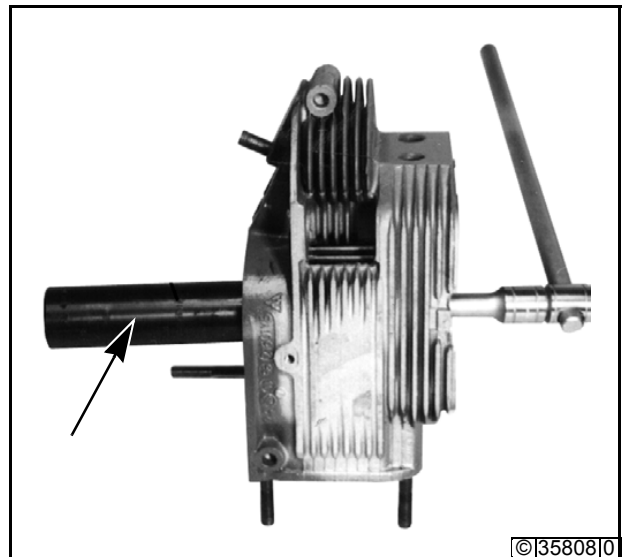
### References

- W 1-5-1
- W 1-7-8

### Remove valve seat insert

#### - Mill valve seat inserts on a lathe

- Remove cylinder head and valves
  - see work card **W 1-5-1**.
- Check valve recess
  - see work card **W 1-7-8**.
- Fit clamping arbor in the cylinder head.

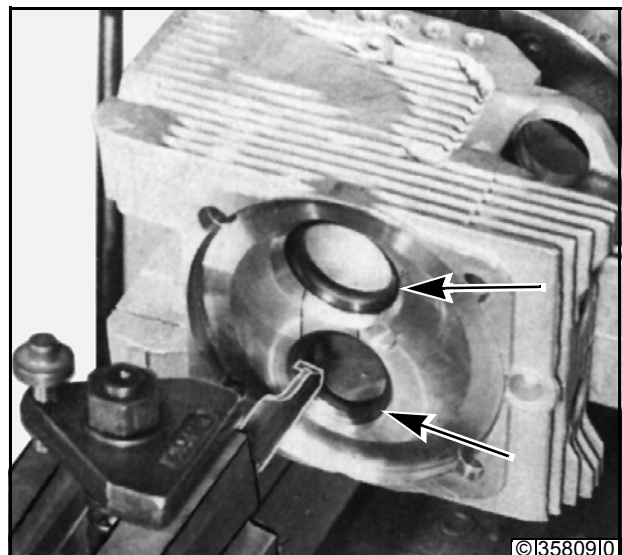


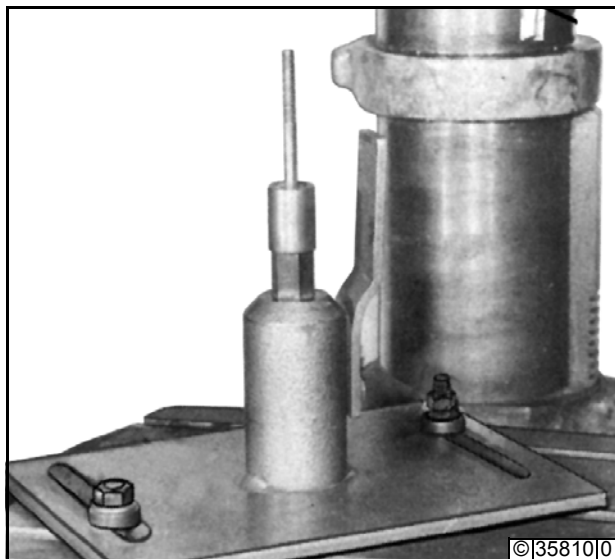
- Mount clamping arbor onto lathe.
- Turn out valve seat inserts until they can be removed free of tension.



### Note

Avoid material damage to the cylinder head.





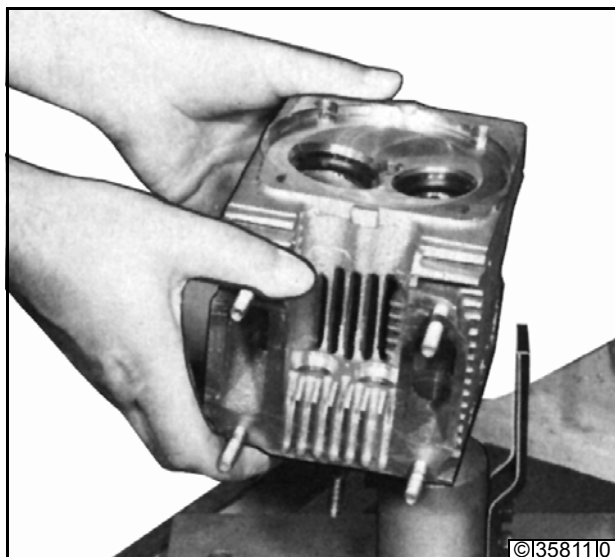
- Remove material from valve seat inserts on an upright drill

- Fit jig and special milling cutter. Do not yet tighten fastening nuts.

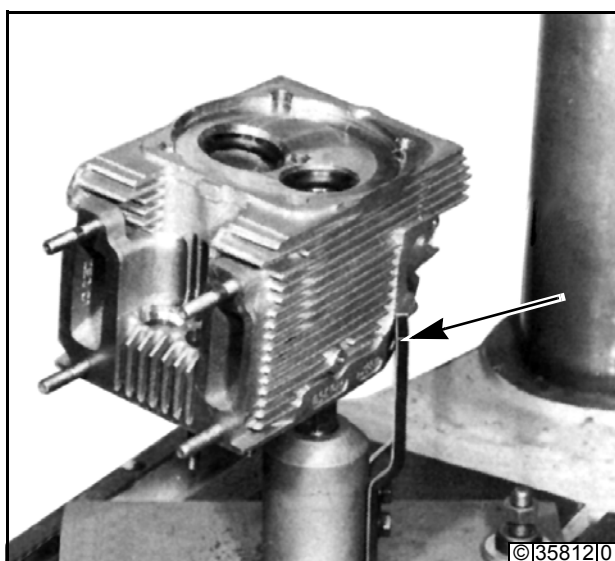


**Note**

Perform the cutting work on an upright drill with a spindle diameter of at least 50 mm and speed of 300 - 350 min rpm.

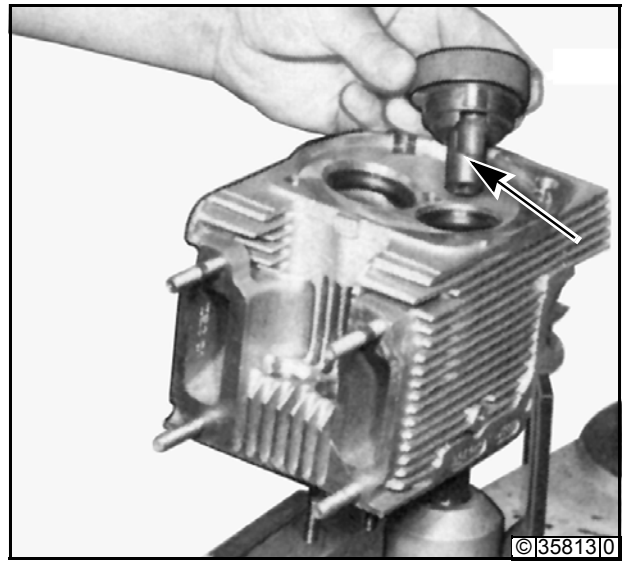


- Place cylinder head onto jig via the valve guide.

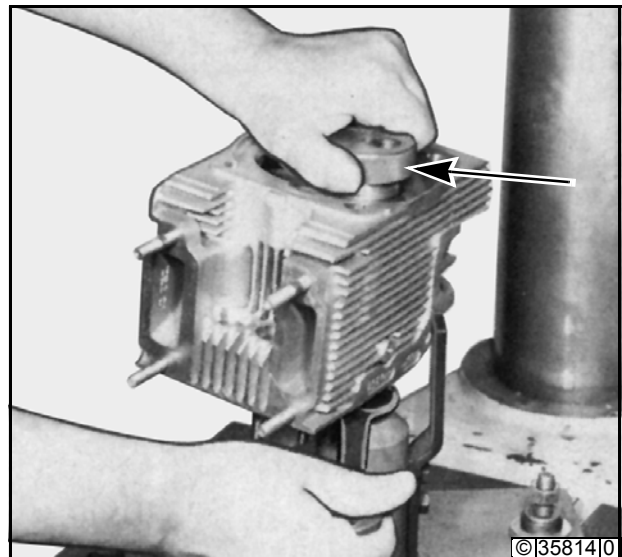


- Press down cylinder head as far as it will go.

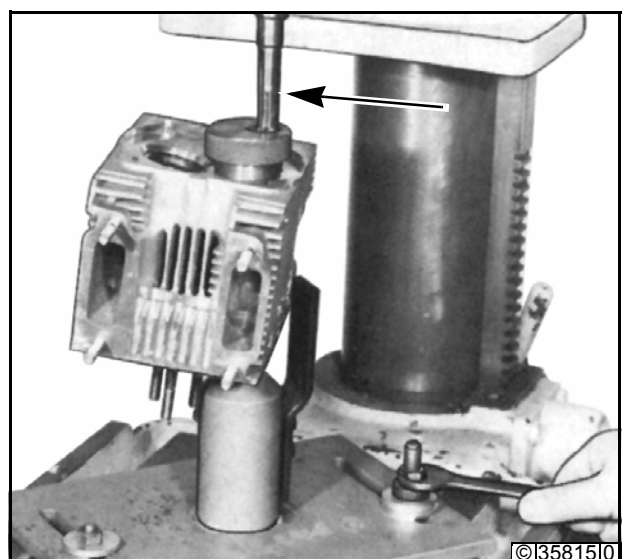
- Screw on drill-jig bush.



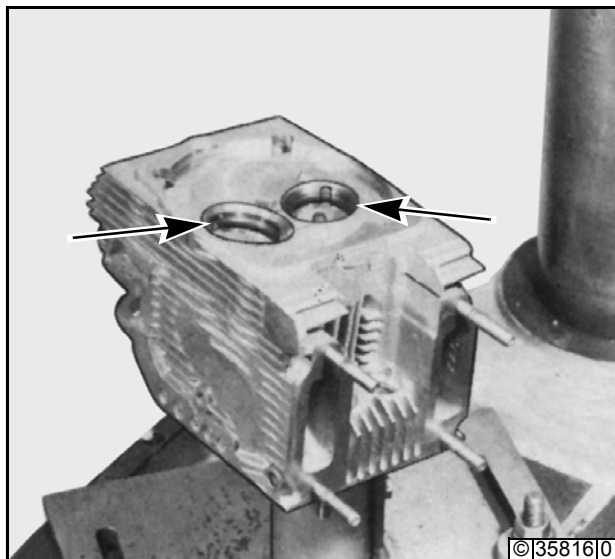
- Tighten drill-jig bush.



- Move special milling cutter to the guide by moving drill in the jig bush accordingly, tighten jig nuts.





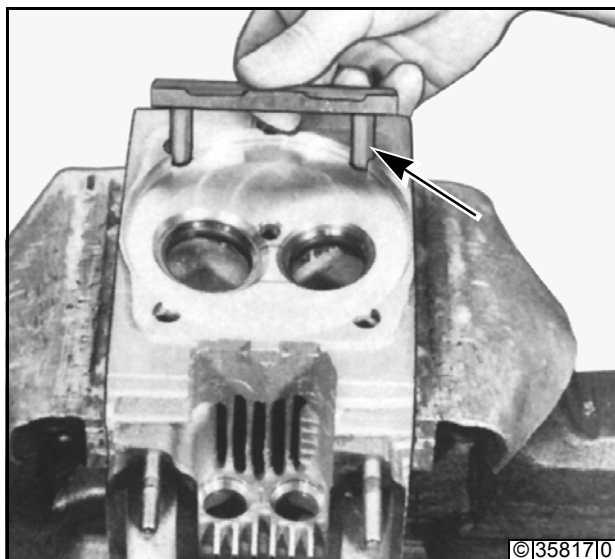


- Mill out valve seat insert.



**Note**

Do not damage the valve seat insert seating face.



- Insert self-made tool.



- Prise out valve seat insert.



**Note**

Do not damage the cylinder head.

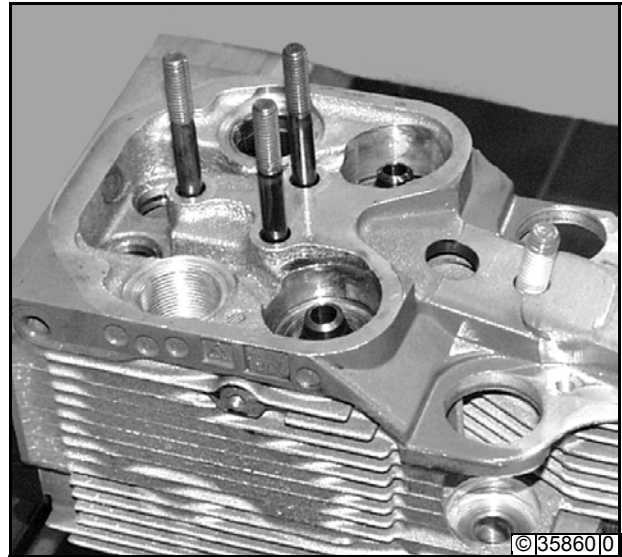
### Install valve seat insert

- Heat cylinder head in heating furnace to 220° C.

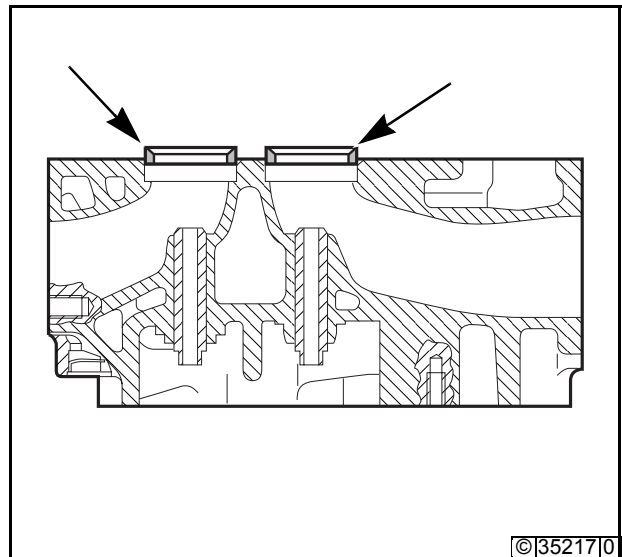


#### Note

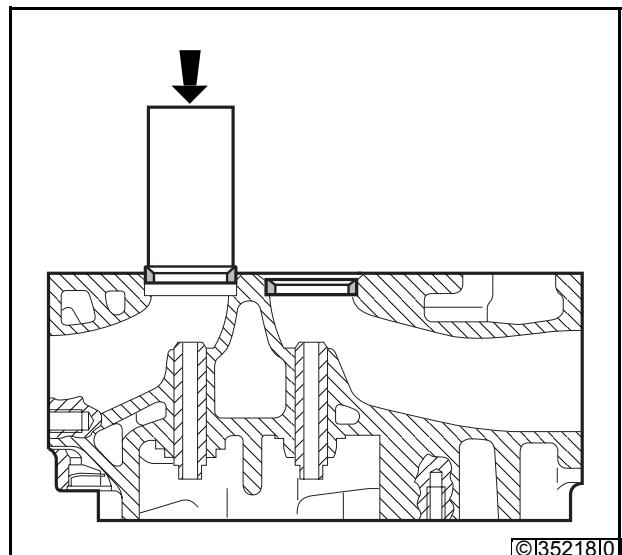
Replace the valve seat inserts after heating the cylinder head once to 220° C.

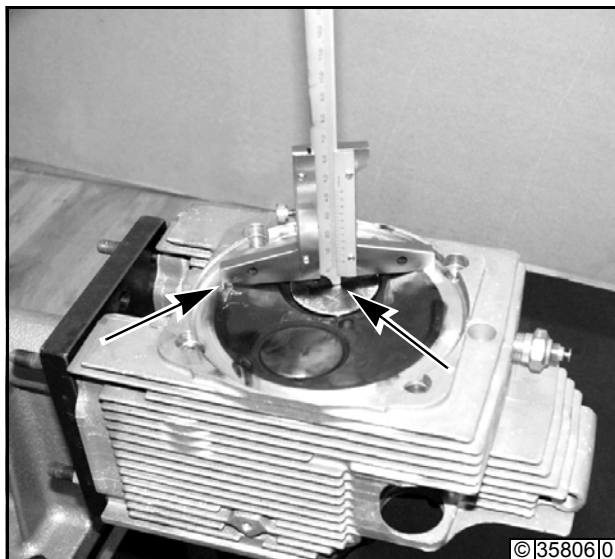


- Fit valve seat inserts.

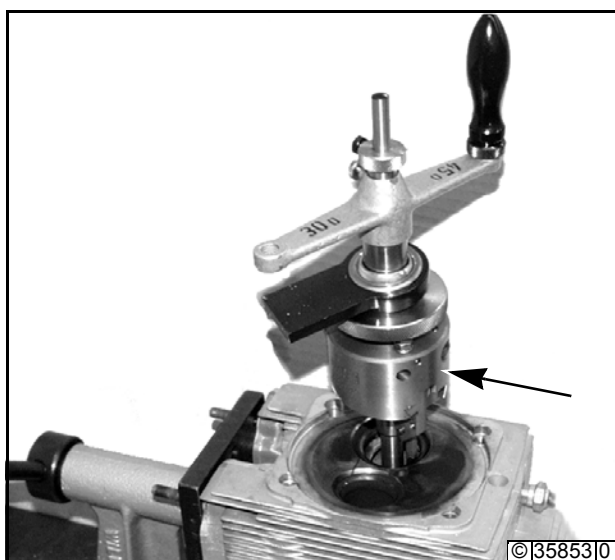


- Place assembly mandrel onto valve seat insert and carefully force in until reaching the stop.

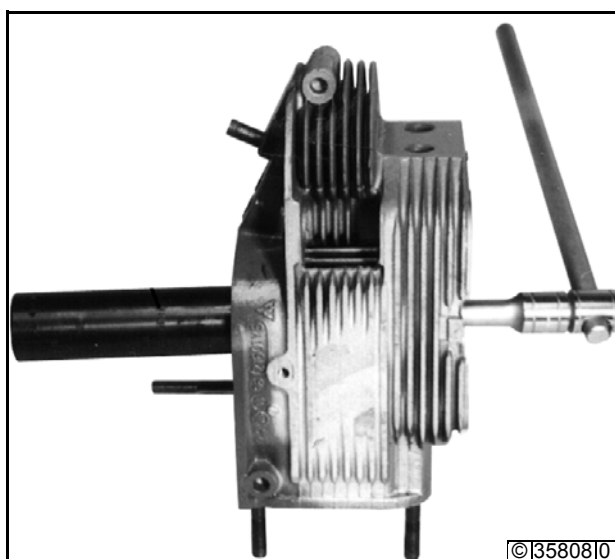




- When the cylinder head has cooled, gauge the recess of the valves from the centre of the cylinder head sealing surface without shim  
- see work card **W 1-7-8**.



- Make any corrections to the valve seat using valve reseating tool.



- Dismount clamping arbor, inset valves and install cylinder head  
- see work card **W 1-5-1**.

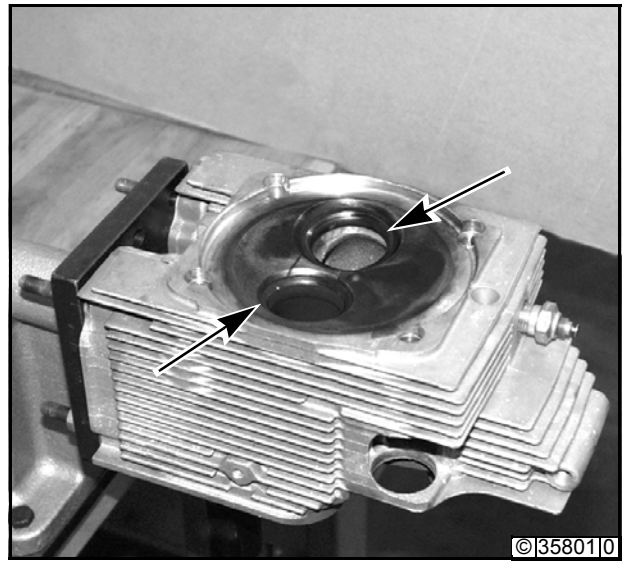


**Check valve seat insert**

- Remove cylinder head and valves  
- see work card **W 1-5-1**.
- Visually inspect valve seat inserts. Monitor dimensions of wear.

**Note**

Replace valve seat inserts if the wear limit have been reached.



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## Checking the valve recess



### Tools

- Commercial tools  
Depth calliper gauge
- Special tools  
Clamping stand \_\_\_\_\_ 120 900  
Clamping plate \_\_\_\_\_ 120 910



### References

- W 1-4-4

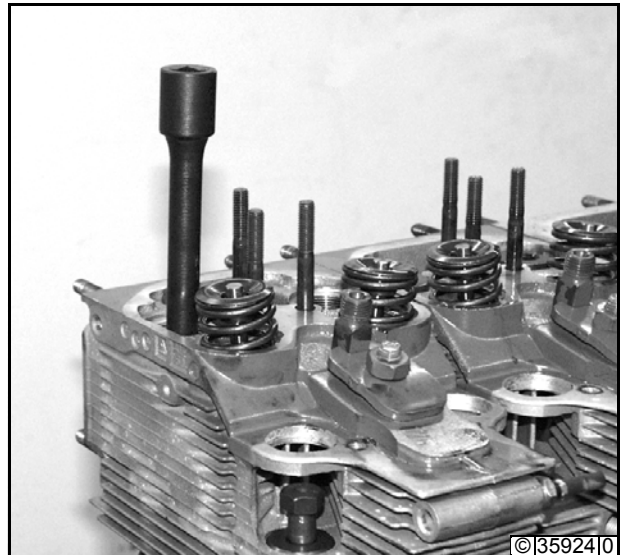


### Note

- Replace the valve seat insert or the individual valves exceed the wear limit, if necessary all together.

### Check valve recess

- Remove cylinder head  
- see work card **W 1-4-4**.
- Place cylinder head onto clamping stand

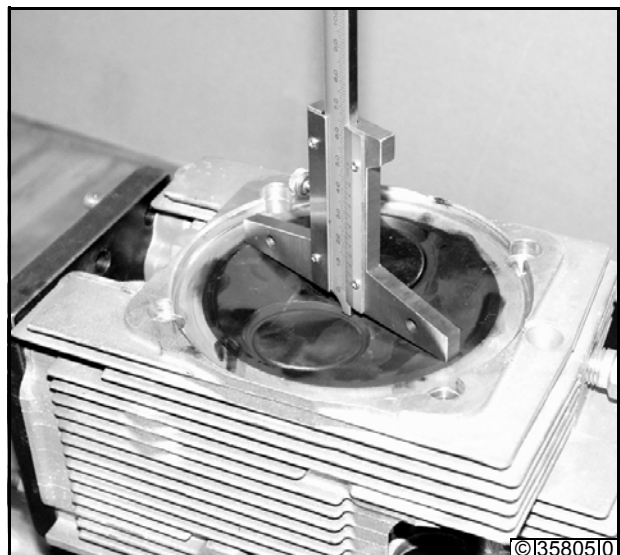


- Gauge recess of cylinder head bottom to cylinder head sealing surface, without shim.



- Note down difference if the actual dimension deviates from the standard dimension.
- Example

Standard dimension                      5.3 mm  
- Actual dimension (measured) 5.1 mm  
= **Difference**                              **0.2 mm**





- Gauge valve recess from the centre of the valve disc to cylinder head sealing surface, without shim.
- Actual dimension + measured **difference of 0.2 mm** gives the actual valve recess.
- Beispiel:  
Actual dimension (measured) 4.0 mm  
**+ Difference 0.2 mm**  
= Actual valve recess 4.2 mm



## Checking the crankshaft



### Tools

- Commercial tools
- Magnetic stand
- External micrometer
- Internal dial gauge
- Prisms
- Hardness tester
- Special tools
- Dial gauge \_\_\_\_\_ 100 400



### References

- W 2-4-1

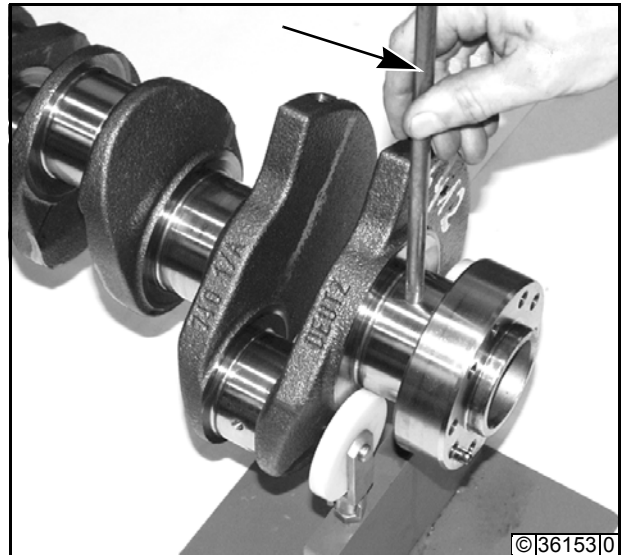
### Check hardness of bearing journals

- Remove crankshaft
  - see work card **W 2-4-1**.
- Place crankshaft onto prisms.
- Check hardness of bearing journals.



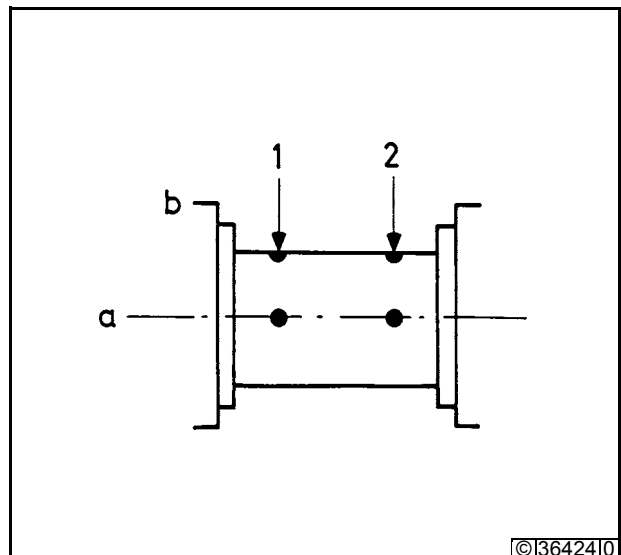
### Note

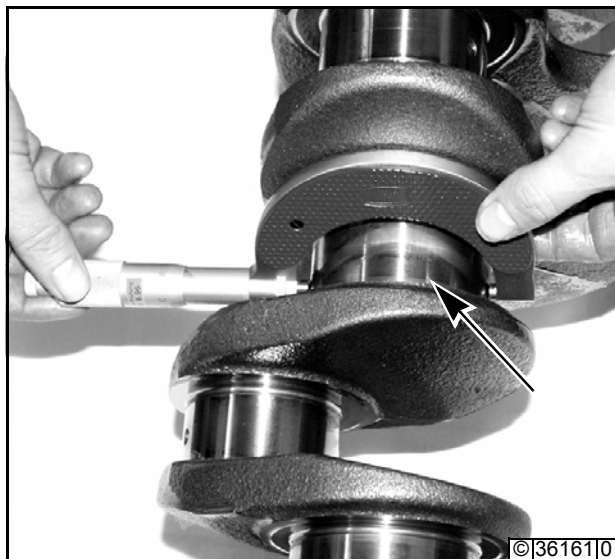
Use the measuring device table to convert the measured values.



### Check crankshaft

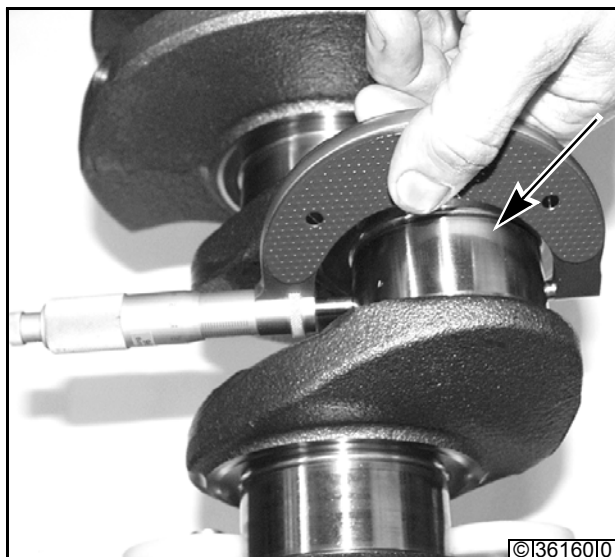
- Schematic for gauging the bearing journals at positions "1" and "2" in levels "a" and "b".





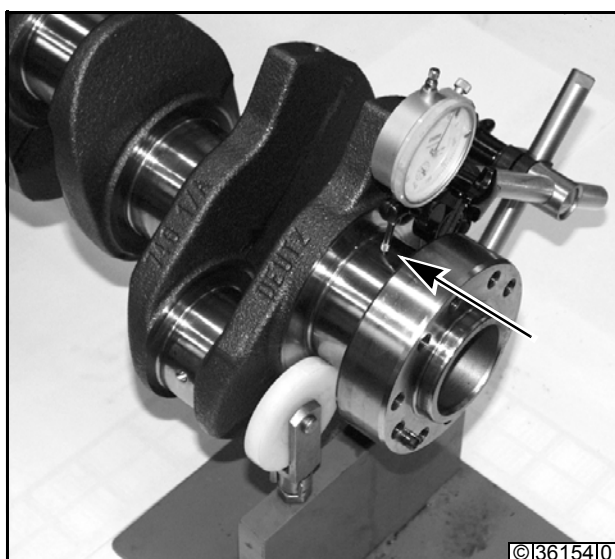
#### Main bearing journal diameter

- Gauge main bearing journal with external micrometer.



#### Crankpin diameter

- Gauge crankpins.



#### True running

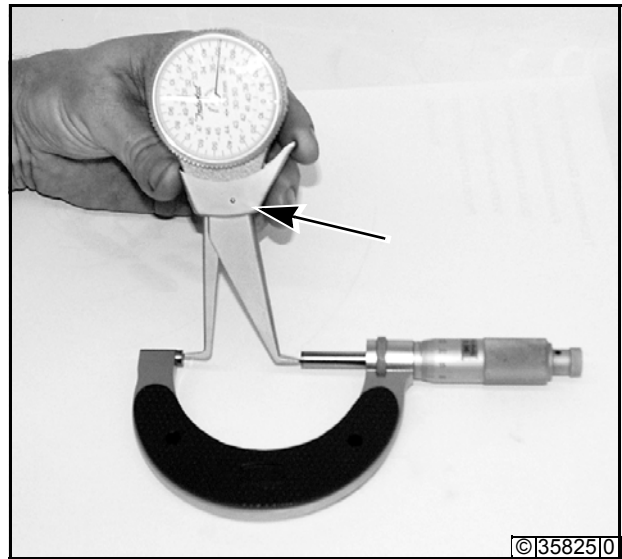
- Check crankshaft for true running.





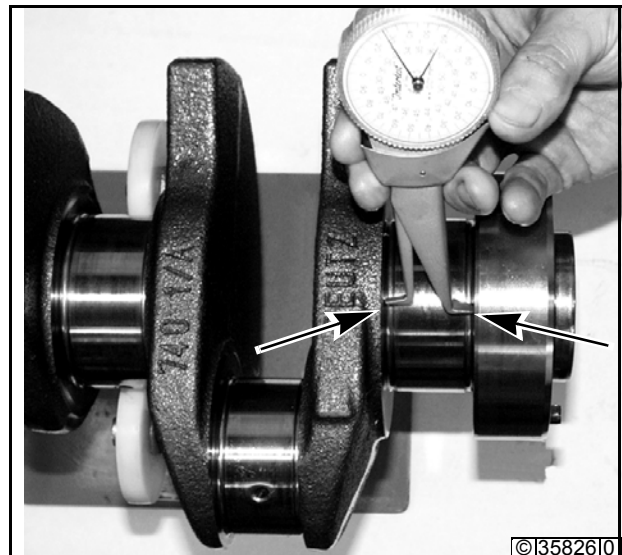
## Determine axial end float

- Adjust internal dial gauge.



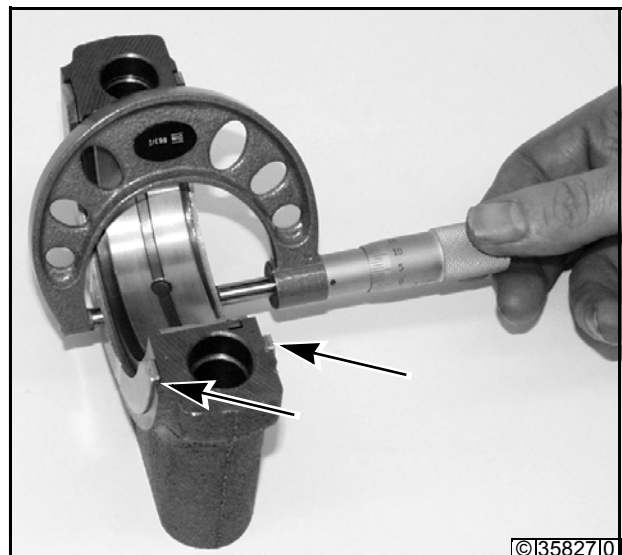
©35825|0

- Gauge width of thrust bearing journal and note the value down. (Dimension "a")

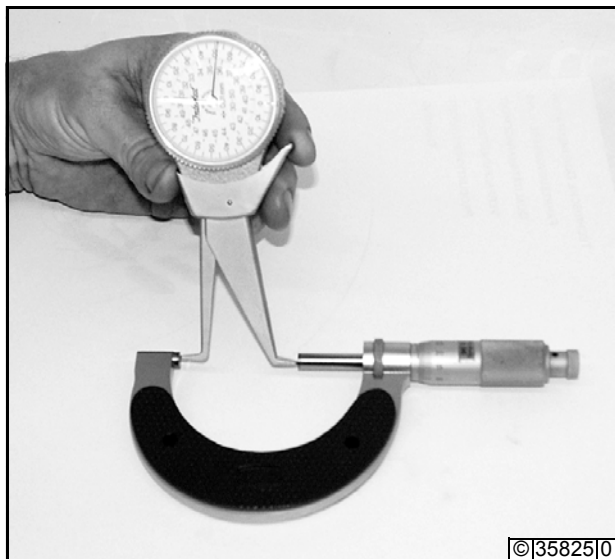


©35826|0

- Place thrust ring halves on thrust bearing cover.
- Gauge width with external micrometer and note down. (Dimension "b")



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- Determine axial end float.

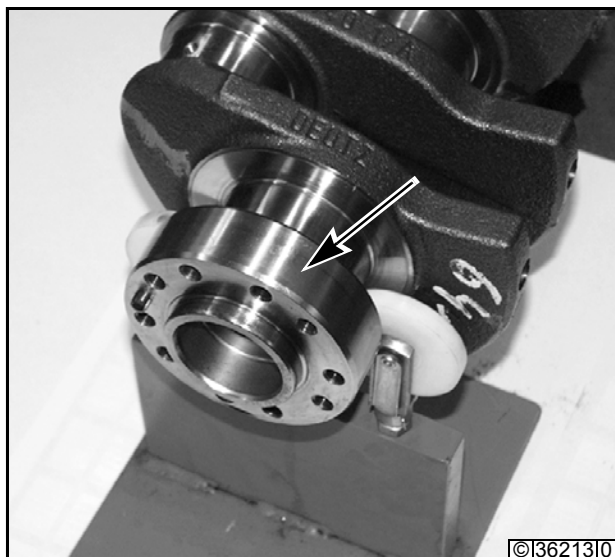
**Axial end float** = Dimension "a" - Dimension "b"

Example:

Dimension "a" = 37,50 mm

Dimension "b" = 37,30 mm

Axial end float = 0,20 mm



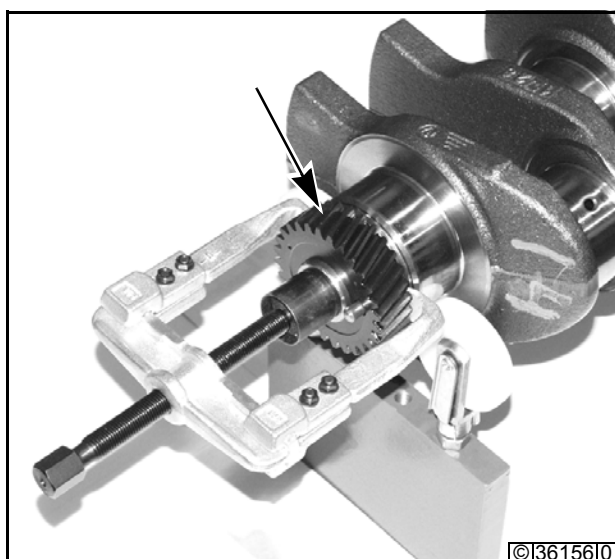
#### Visual inspection

- Visually inspect the running surface of the shaft seal.



#### Note

If the crankshaft is worn, it is possible to procure a replacement shaft or have the old one repaired at our Service Centers.



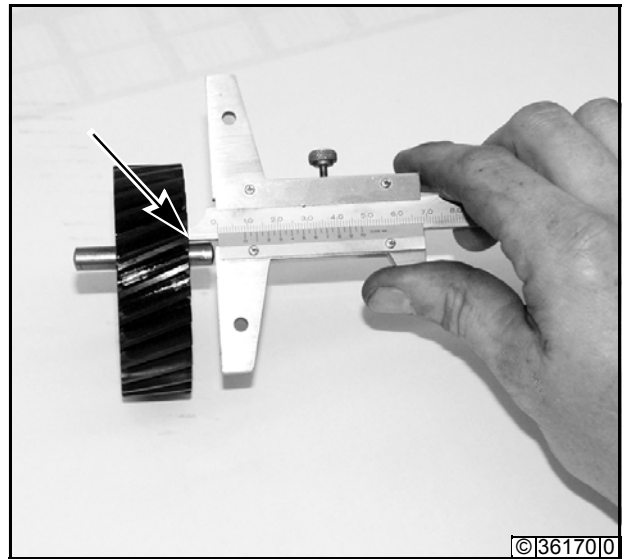
- Visually inspect gear for wear, pull off if necessary.



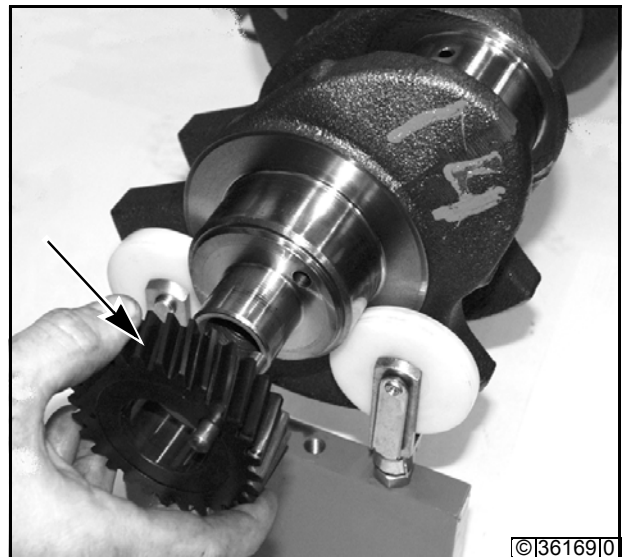
- Gauge projection of notched pin in the gear and correct, if necessary.

**Note**

The punch mark of the gear is on the shorter side of the notched pin.



- Slide gear on until the stop is reached.



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## Renewing the crankshaft seal (coupling side) on complete engine



### Tools

- Special tools
- Retainer plate \_\_\_\_\_ 142 070
- Fitting device \_\_\_\_\_ 142 080
- Extracting device \_\_\_\_\_ 142 700
- Centering device \_\_\_\_\_ 143 110
- Retainer \_\_\_\_\_ 143 400

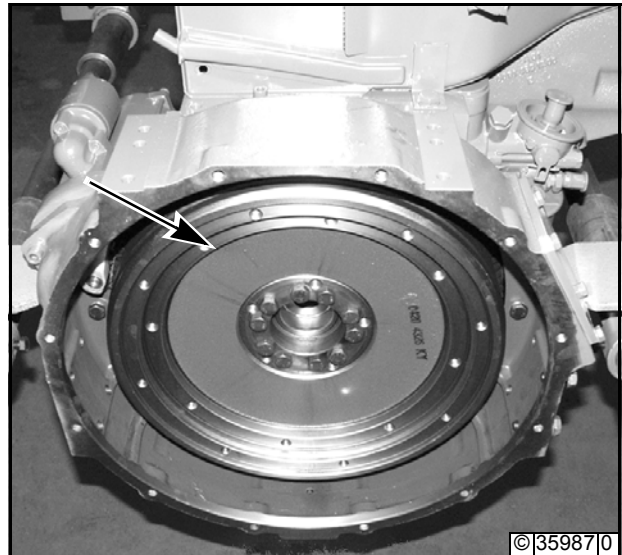


### References

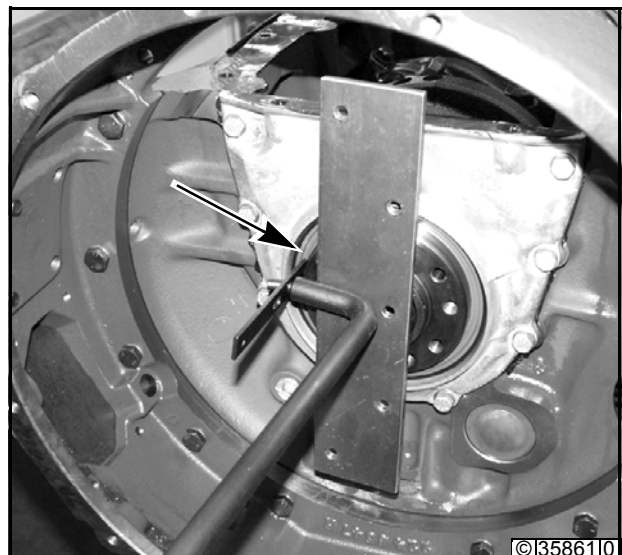
- W 12-6-1

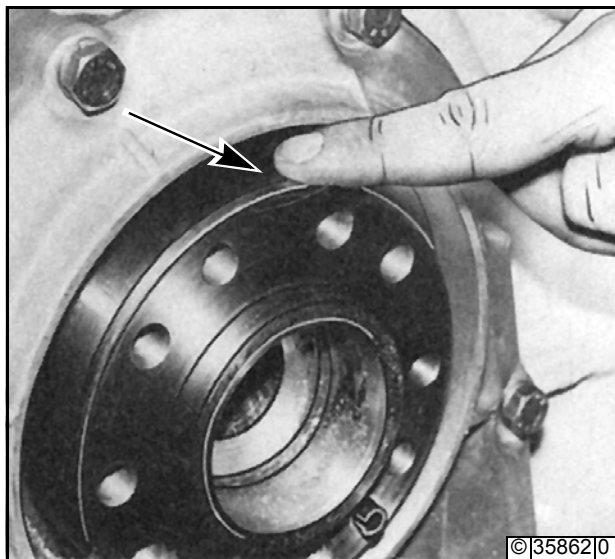
### Renew crankshaft seal

- Hold flywheel securely and remove.



- Prise out shaft seal with extracting device and retainer plate.



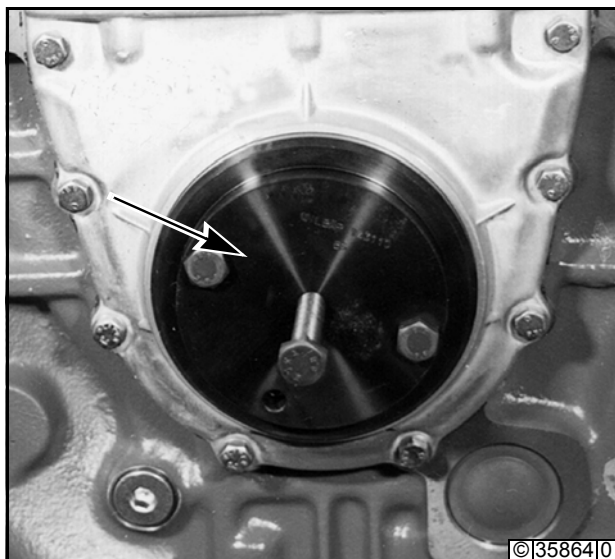


- Visually inspect running surface of seal for damage.



**Note**

In case of existing run-in groove, displace new shaft seal axially.  
See marking on fitting device for installation depth.



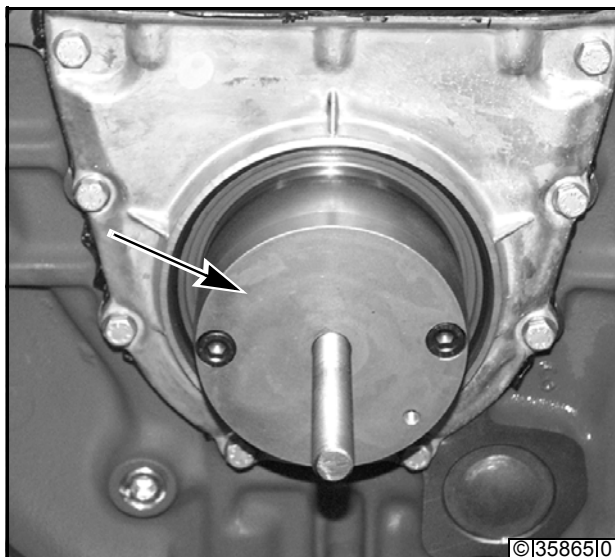
**Note**

Before installing the new shaft seal, check the concentricity of the crankshaft flange and rear cover with centering device (arrow).



**Note**

In case of deviation, remove rear cover and oil pan  
- see work card **W 8-4-7**.



- Bolt on guide element of fitting device.



## Note

Installation depth possibilities:  
Installation depth 0 standard dimension with perfect shaft seal running surface.

Installation depth 1 with existing run-in groove on the shaft seal running surface.



©35863|0

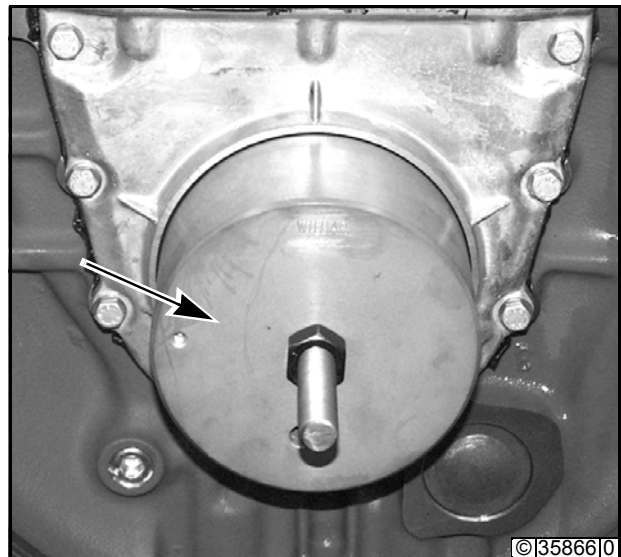
- Lightly oil sealing lip of shaft seal.



## Note

Sealing lip faces the crankshaft.

- Mount new shaft seal on the fitting device.
- Mount shaft seal flush with fitting device.



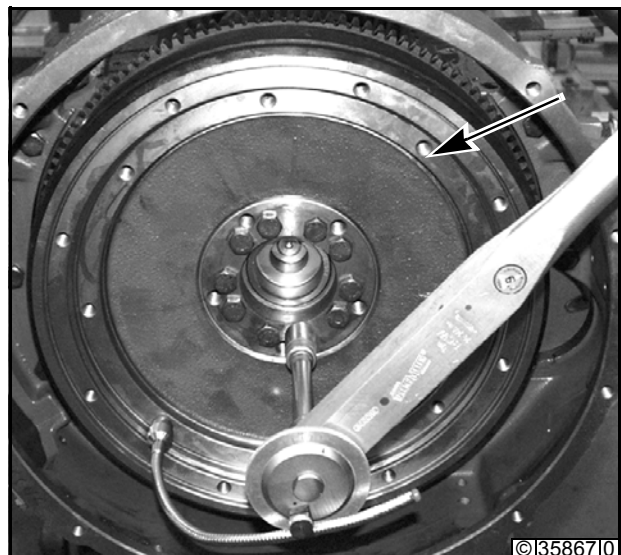
©35866|0

- Tighten flywheel with new bolts in accordance with torque specifications.



## Note

Hold against the V-belt pulley with the retainer, if necessary.



©35867|0

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## Renewing the crankshaft seal (opposite end to coupling) of complete engine



### Tools

- Special tools
- Tightening angle dial indicator \_ 101 910
- Fitting device \_ 142 060
- Extracting device \_ 142 700
- Retainer \_ 143 400

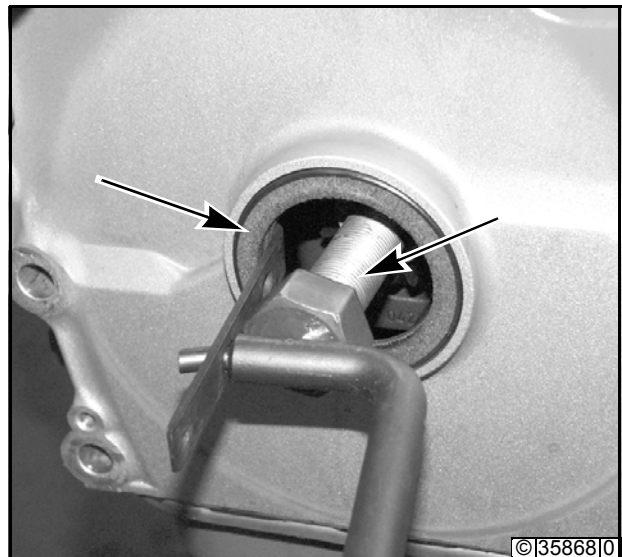


### References

- W 12-1-4

### Renew crankshaft seal

- Remove rotary vibration damper  
- see work card **W 12-1-4**.
- Screw in fastening bolt and prise out shaft seal  
with extracting device.



- Visually check running surface of the seal on  
rotary vibration damper for damage.
- In case of existing run-in groove, displace new  
shaft seal axially. See marking on press-in tool for  
installation depth.

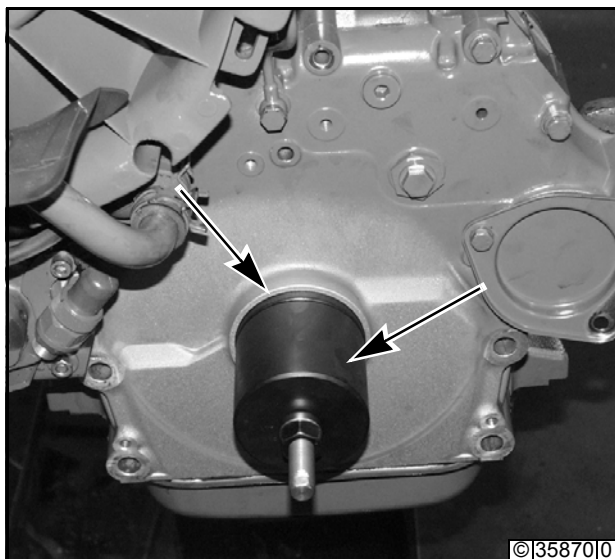




**Note**

Installation depth possibilities:  
Installation depth 0 standard dimension with perfect shaft seal running surface.

Installation depth 1 with existing run-in groove on the shaft seal running surface.

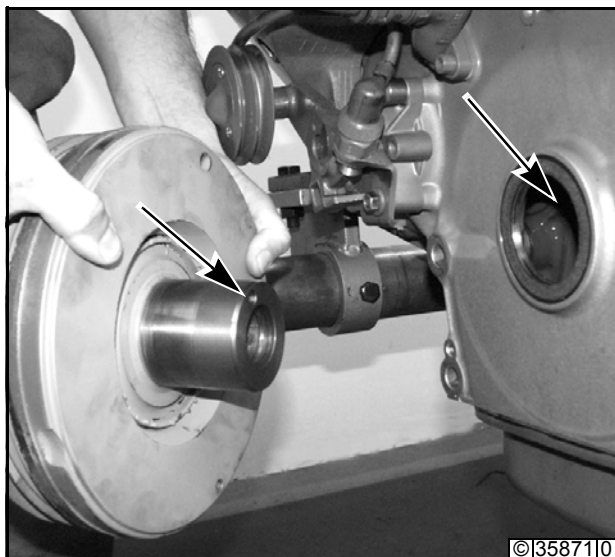


- Mount new shaft seal with fitting device.



**Note**

Sealing lip faces the crankshaft.



- Lightly oil sealing lip of shaft seal.
- Line up the alignment pin in crankshaft with the bore.
- Install rotary vibration damper and tighten in accordance with torque specifications.  
- see work card **W 12-1-4**.





## Checking the connecting rod

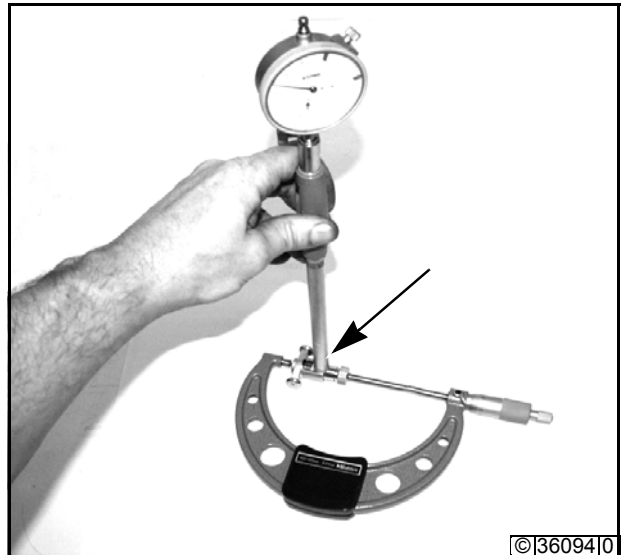


### Tools

- Tools
  - External micrometer
  - Connecting rod testing device
- Special tools
  - Dial gauge \_\_\_\_\_ 100 400

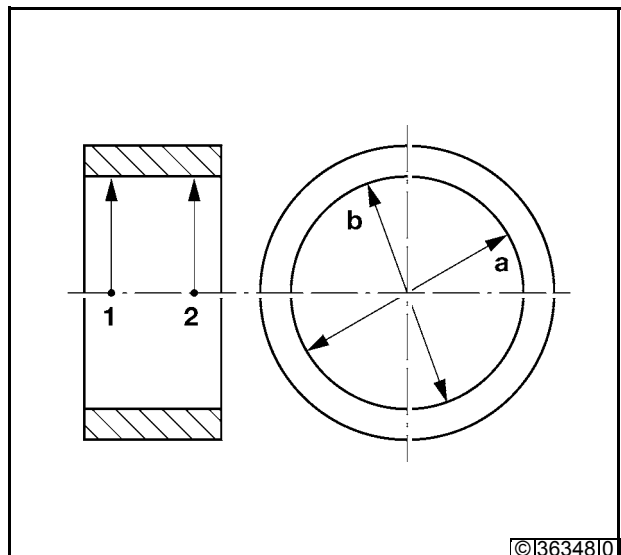
### Check small end bush

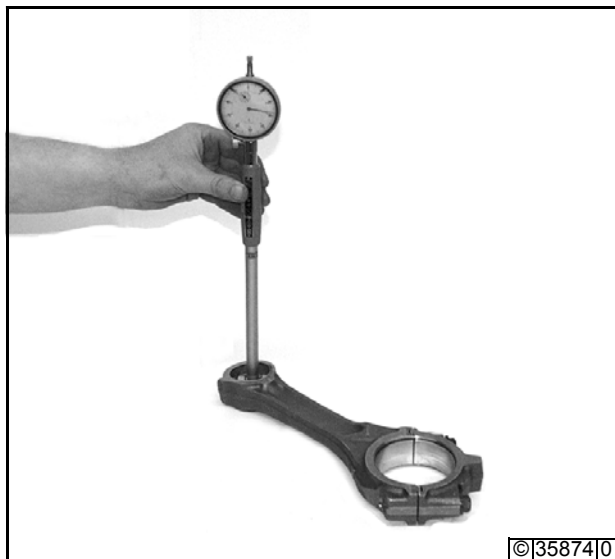
- Use and set internal dial gauge with tracer pin for measuring range 35 - 45 mm



### Note

Gauge small end bush at points "1" and "2" in planes "a" and "b".





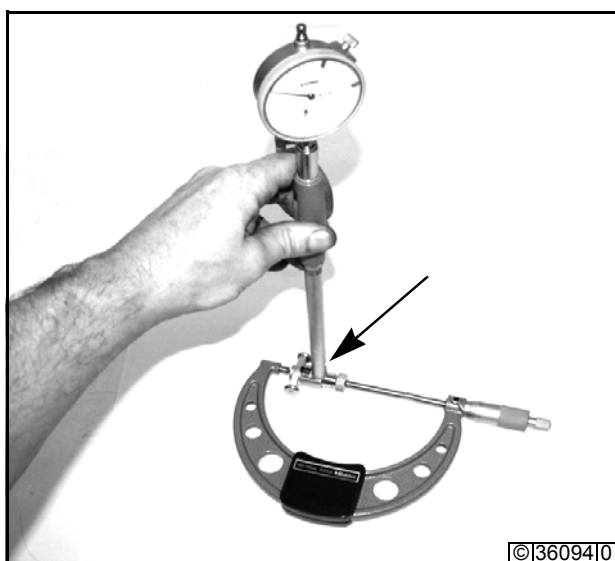
**Small end bush pressed in**

Specified value:



**Piston pin diameter**

- Check piston pin for wear.



**Check bore for big end bearing**

- Use and set internal dial gauge with tracer pin for measuring range 60 - 70 mm.

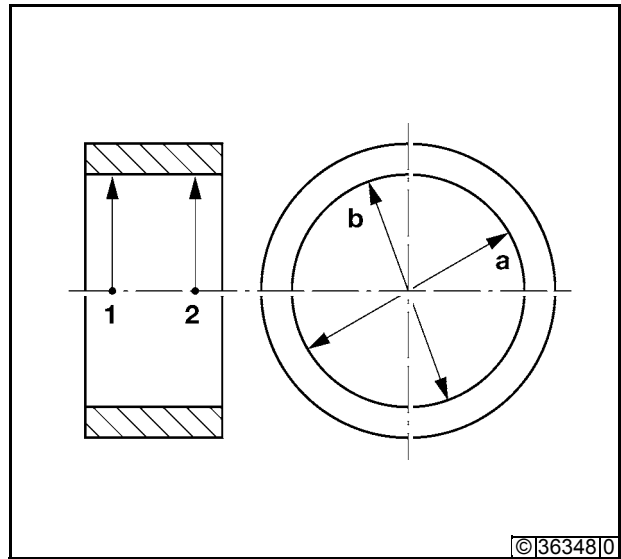




## Note

Schematic for gauging the bore for big end bearing at points "1" and "2" in planes "a" and "b".

Bore for big end bearing:

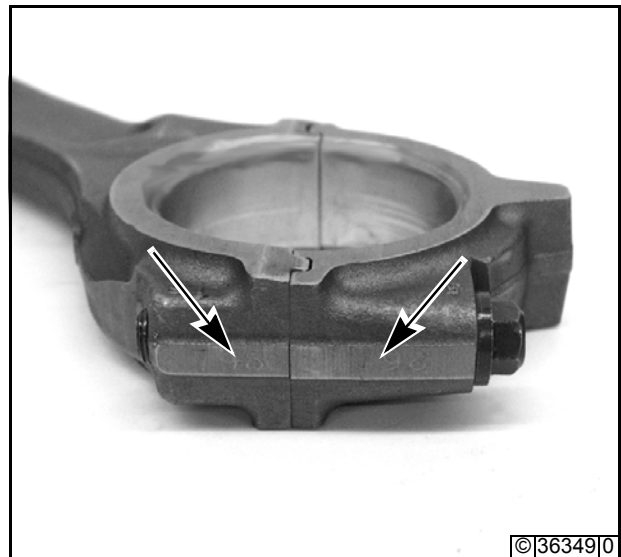


- Make sure that cap mates with big end bearing.

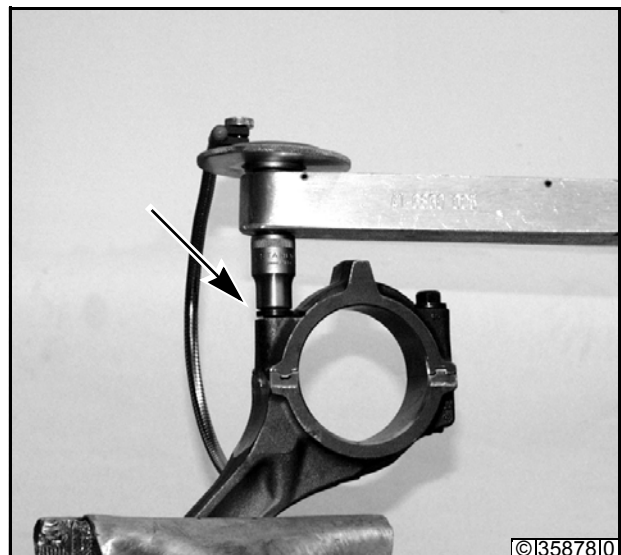


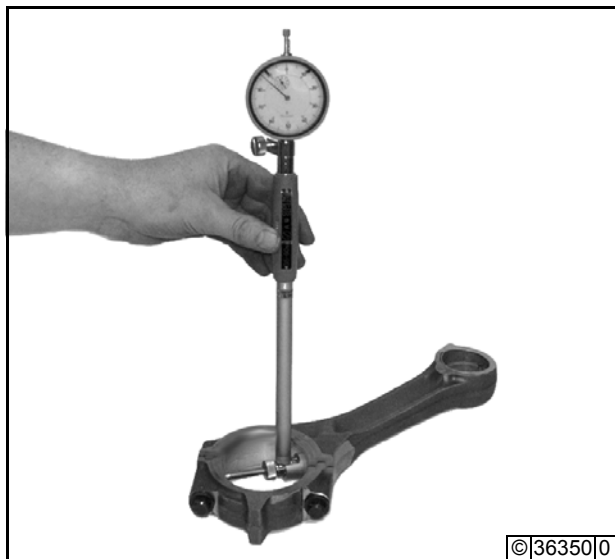
## Note

ID-codes of connecting rod and big end bearing cap must be identical.



- Remount big end bearing cap. Tighten bolts.





**Note**

If the gauge readings conform to the specified values, the necessary preload will be obtained after fitting the bearing shells.



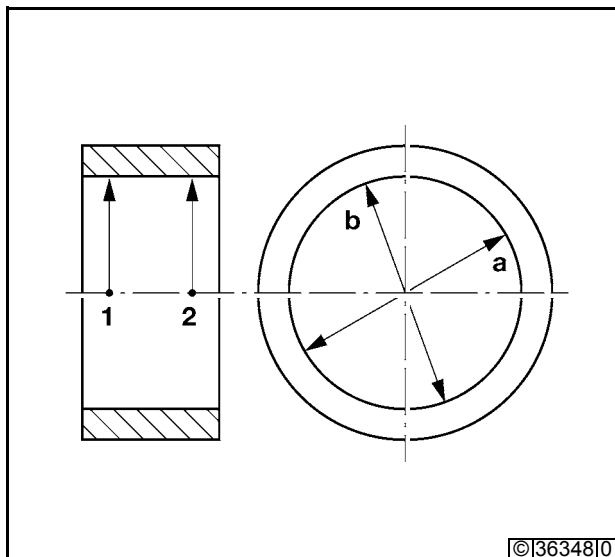
**Note**

If the measured values deviate only slightly, take further measurements with the new bearing shells fitted.



**Check inner diameter of big end bearing**

- Remove cap from big end bearing and fit new bearing shells.
- Remount big end bearing cap. Tighten bolts.



- Set internal dial gauge.



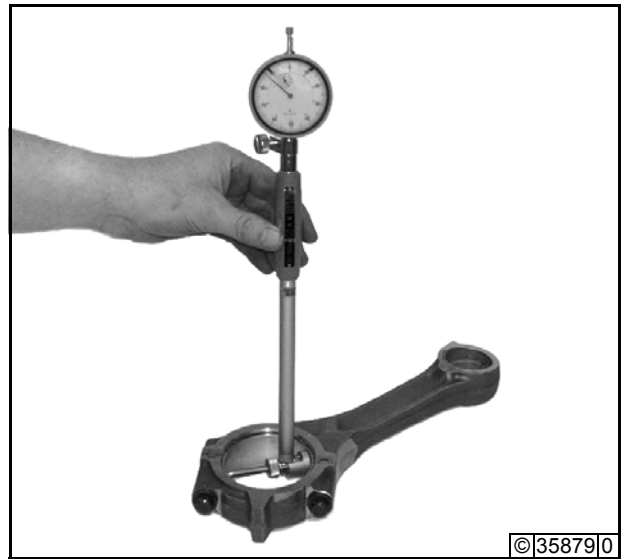
**Note**

Gauge bearing shells at points "1" and "2" in planes "a" and "b".

Inner diameter of big end bearing shells:



Limit for undersize:

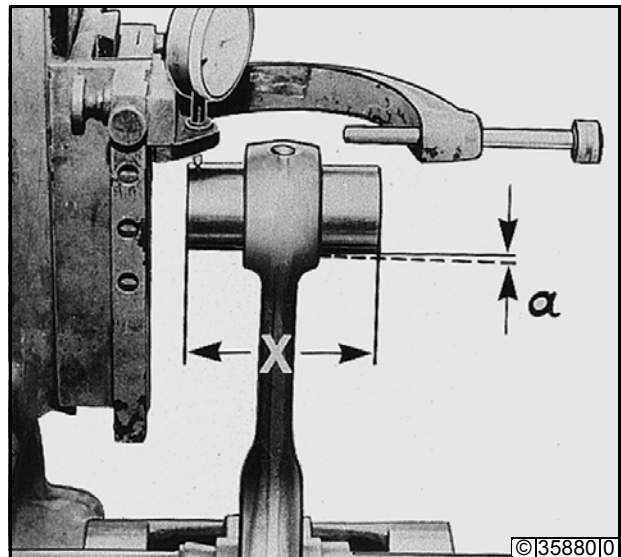


© 35879|0

### Check connecting rod for parallelism

- Check connecting rod without bearing shells on connecting rod tester.

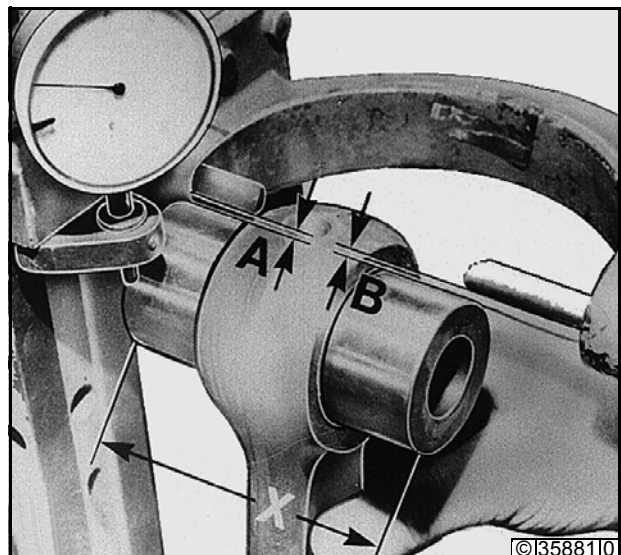
Permissible tolerance "A" to "B" = max. **0.06 mm**  
over a distance of "x" **100 mm**.



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### Check connecting rod for squareness

Permissible tolerance "A" to "B" = max. **0.06 mm**  
over a distance of "x" = **100 mm**.



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## Removing and refitting the crankshaft



### Tools

- Commercial tools

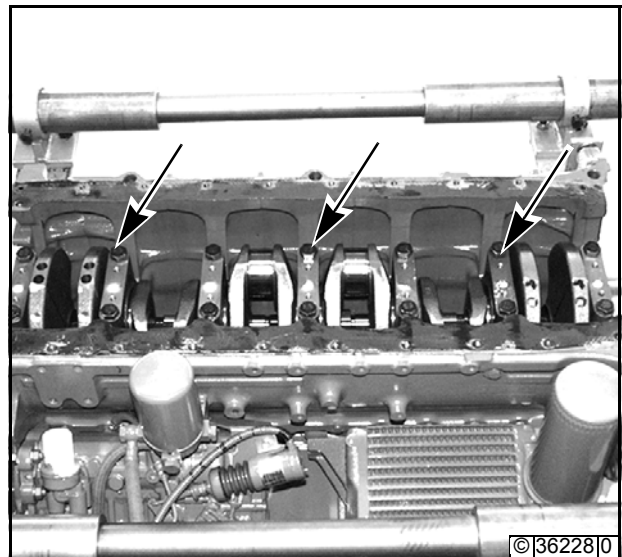


### References

- W 2-1-7
- W 3-8-1
- W 3-9-1

### Remove crankshaft

- Remove front cover (opposite the coupling end) and oil pan  
- see work card **W 3-8-1**.
- Remove rear cover (coupling end)  
- see work card **W 3-9-1**.
- Remove lube oil suction pipe and main bearing cap.
- Remove big end bearing cap.



- Take out crankshaft, main bearing and thrust ring.



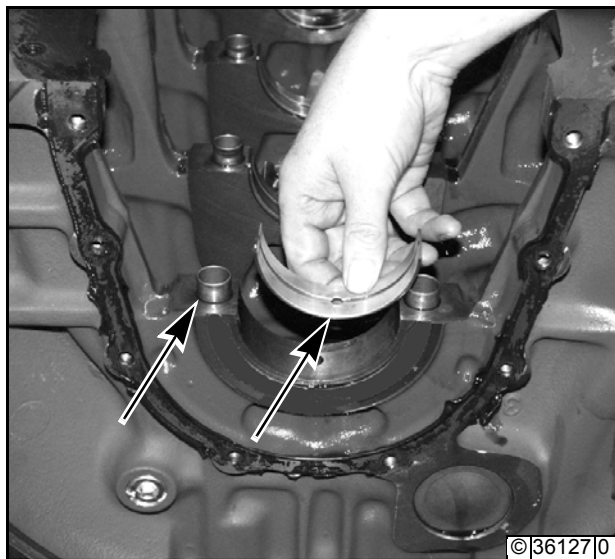
### Note

Be careful with thrust ring. Lay down parts of main bearing cap in their sequence of removal.

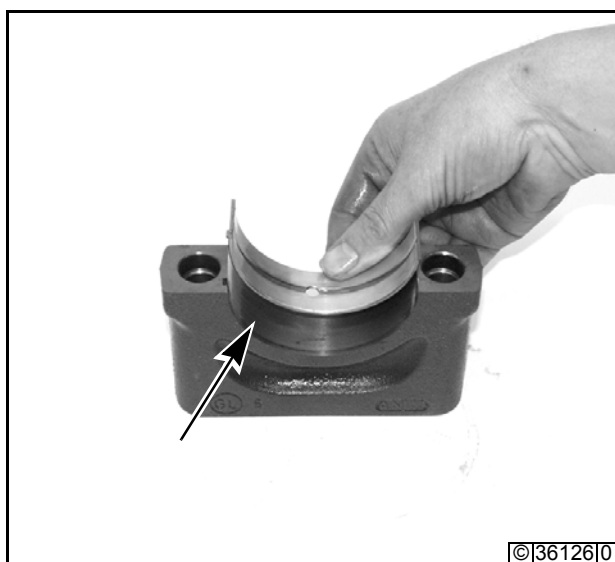
- Remove bearing shells.



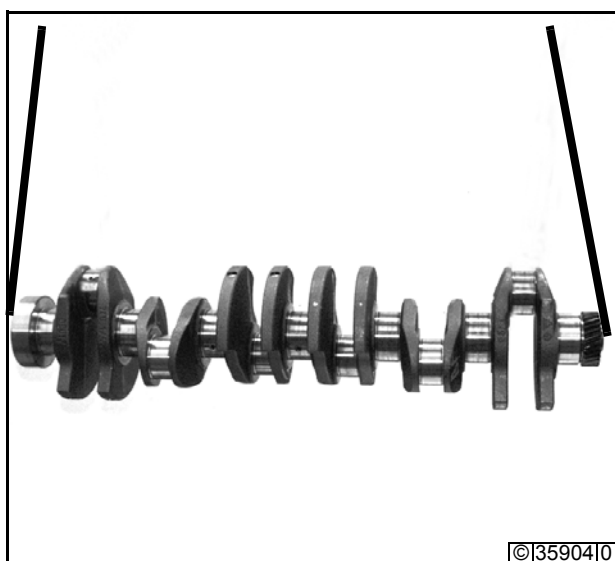




- Insert bearing shell.
- Check that clamping bushes are present, insert if necessary.



- Insert bearing shell in main bearing cap.



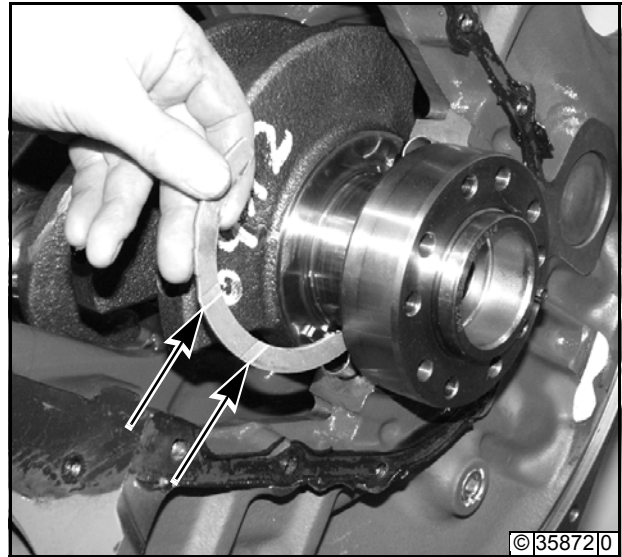
- Check axial clearance of crankshaft  
- see work card **W 2-1-7**.
- Install crankshaft.



- Insert thrust ring halves without guide lug so that the oil grooves face the crankweb.


**Note**

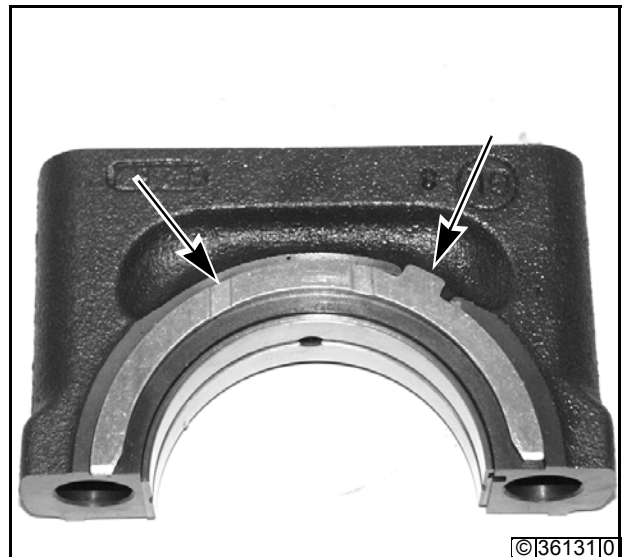
The larger thrust ring half faces the flywheel end.



- Adhere thrust ring halves with guide lug to the thrust bearing with a little grease so that the oil grooves face the crankweb.


**Note**

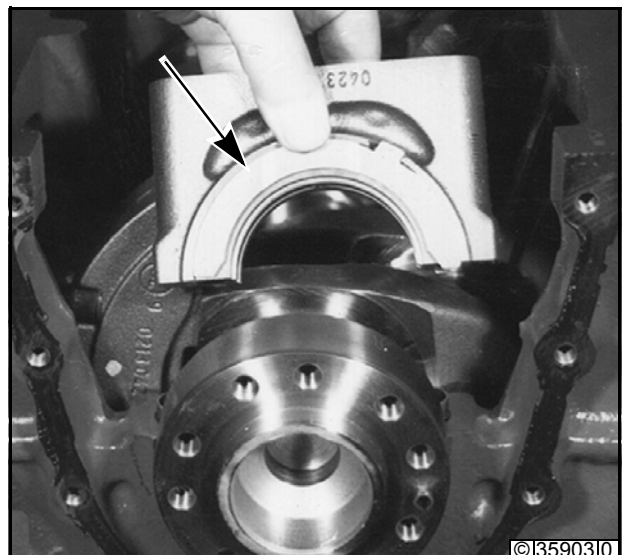
The larger thrust ring half faces the flywheel end.



- Remount thrust bearing cap.

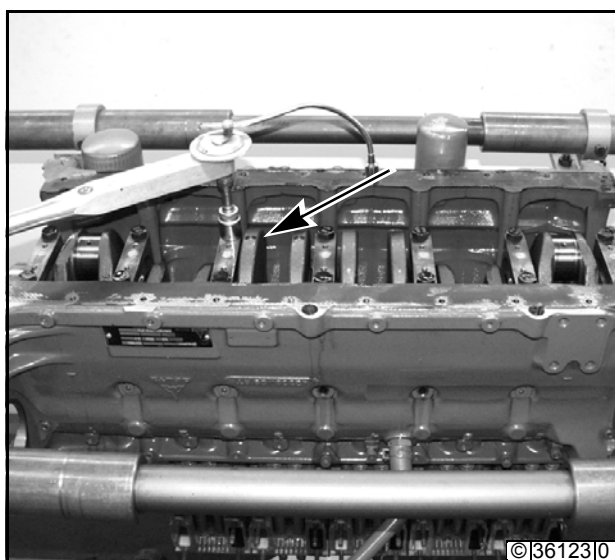

**Note**

Bearing cap no. 1 is at the flywheel end.

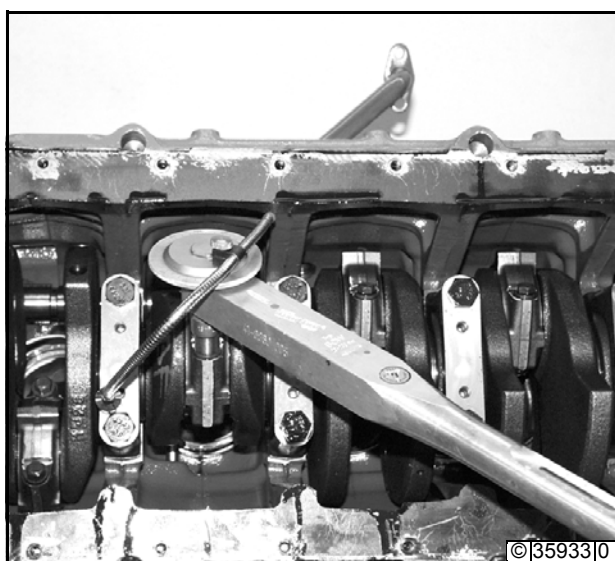




- Fit main bearing cap paying attention to the numbering.



- Tighten main bearing bolts.



- Install big end bearing cap with bearing shells and tighten bolts.



- Refit front cover and oil pan  
- see work card **W 3-8-1**.
- Refit rear cover  
- see work card **W 3-9-1**.

## Checking the piston



### Tools

- Commercial tools
- External micrometer
- Special tools
- Dial gauge \_\_\_\_\_ 100 400

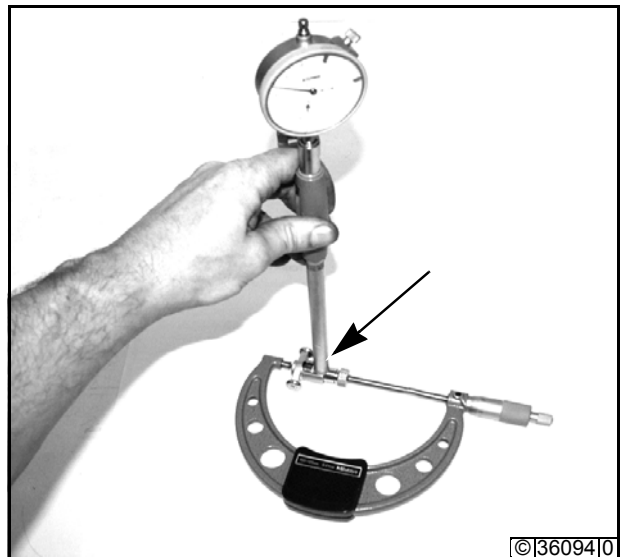


### References

- W 3-2-4

### Check piston

- Remove piston and cylinder  
- see work card **W 3-2-4**.
- Use and set internal dial gauge with tracer pin for  
measuring range 35 - 45 mm.

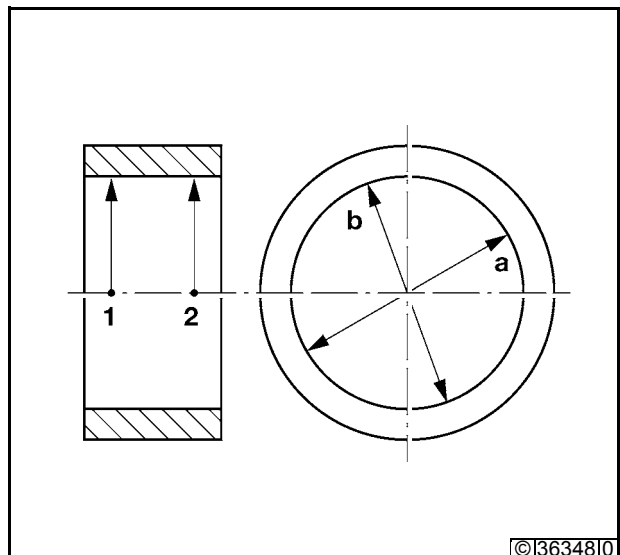


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### Note

Gauge piston pin bore at points "1" and "2"  
in planes "a" and "b".



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- Gauge piston pin bore.



**Note**

The piston diameter is gauged at the bottom of the shank end, crosswise to the piston pin bore.

- Check piston diameter for wear.



- Refit piston and cylinder  
- see work card **W 3-2-4**.

## Checking the piston and grooves



### Tools

- Special tools
- Feeler gauge \_\_\_\_\_ 101 630
- Piston ring pliers \_\_\_\_\_ 130 300
- Trapezoid groove wear gauge \_ 130 360

- Adjust piston ring-pliers to the piston diameter.
- Remove piston rings.

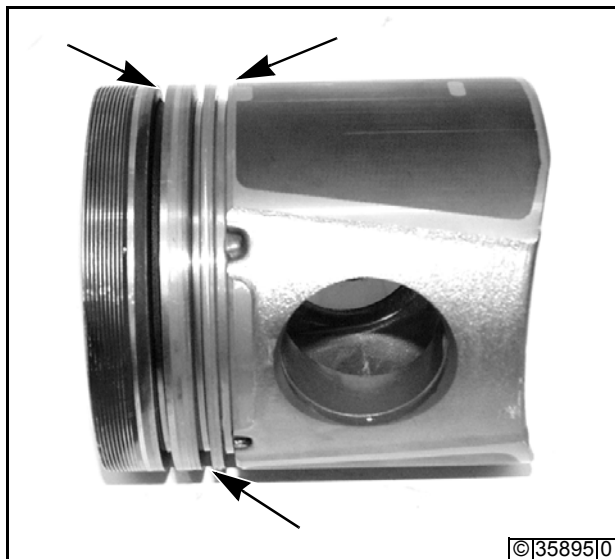


©35898|0

- Insert piston ring in cylinder and push down with piston.
- Measure piston ring gap clearance with feeler gauge.



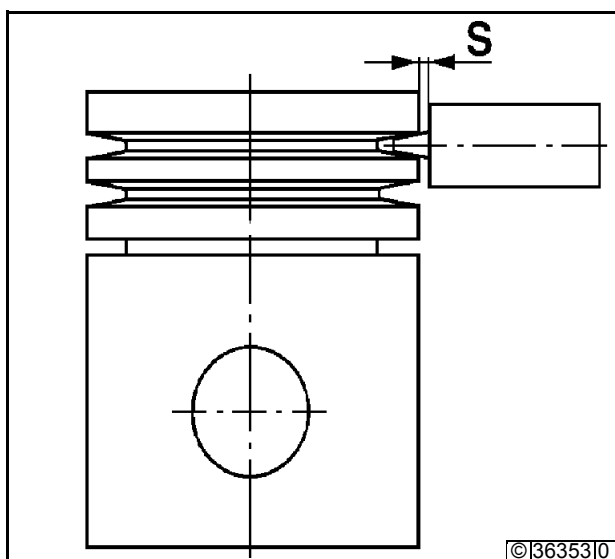
©35911|0



- Clean and visually inspect piston and ring grooves.



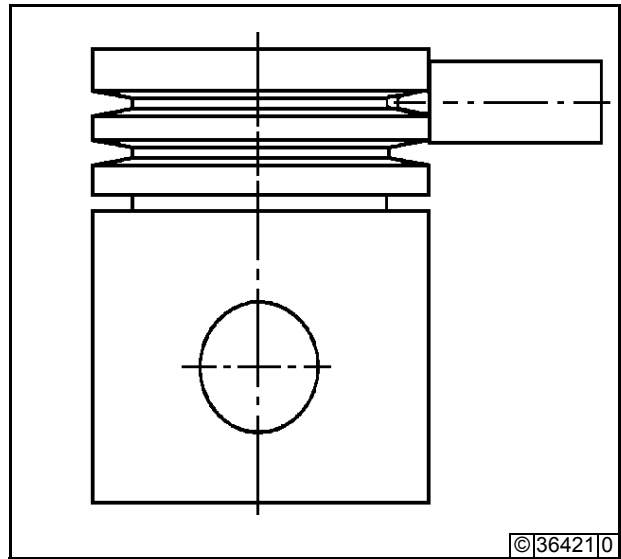
- Measure trapezoid groove of 1st and 2nd piston rings with trapezoid groove wear gauge.



- If there is a distance "S" between the trapezoid groove wear gauge and the piston, the piston can continue to be used.



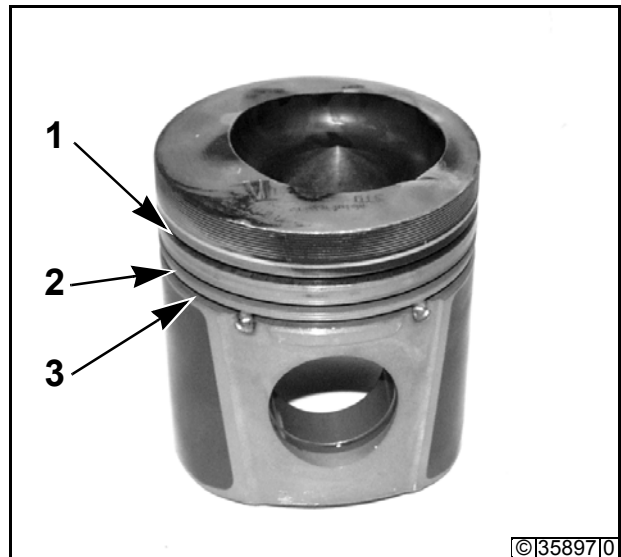
- If the trapezoid groove wear gauge touches the piston, the piston must be replaced.



#### Note

Sequence and position of piston rings seen from piston crown:

1. Keystone ring, top facing combustion chamber.
2. Keystone ring, top facing combustion chamber.
3. Bevel-edged slotted oil control ring with hose spring.



- Fit piston rings with piston ring pliers.
- Spring gap of bevel-edged ring to be offset by 180° to ring gap.





- Measure groove of 3rd piston ring (bevel-edged ring) with feeler gauge.
- Take the measurement with new piston rings fitted.
- Axial clearance, 3rd ring





## Removing and refitting the piston and cylinder



### Tools

- Commercial tools
- External micrometer
- Special tools
- Cylinder head wrench \_\_\_\_\_ 120 040
- Piston ring tensioning belt \_\_\_\_\_ 130 600

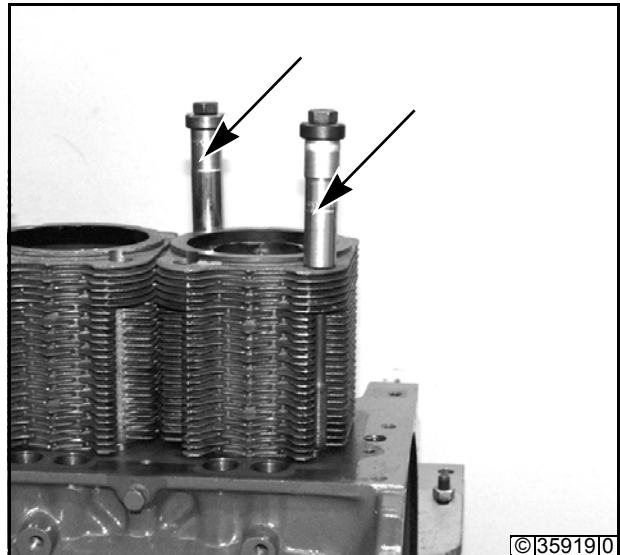


### References

- W 1-4-4
- W 8-4-6

### Remove piston and cylinder

- Remove cylinder head
  - see work card **W 1-4-4**.
- Secure cylinder so that it cannot fall out.
- Remove oil pan and oil suction pipe
  - see work card **W 8-4-6**.



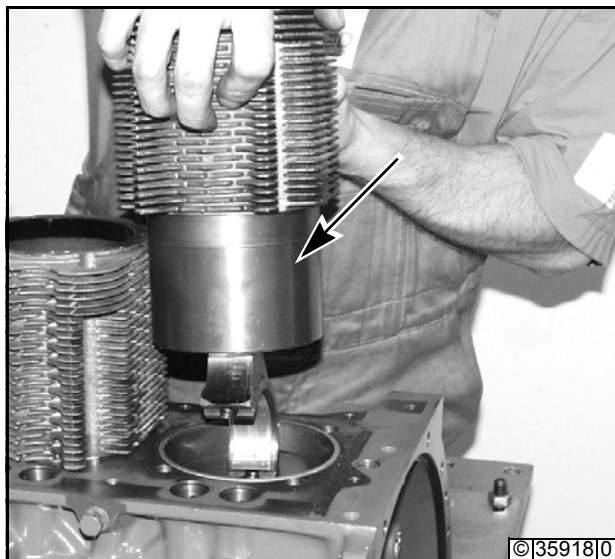
- Turn engine by 90°. Remove big end bearing caps.



### Note

Pay attention to big end bearing shells.  
Lay down parts in the order they were disassembled.

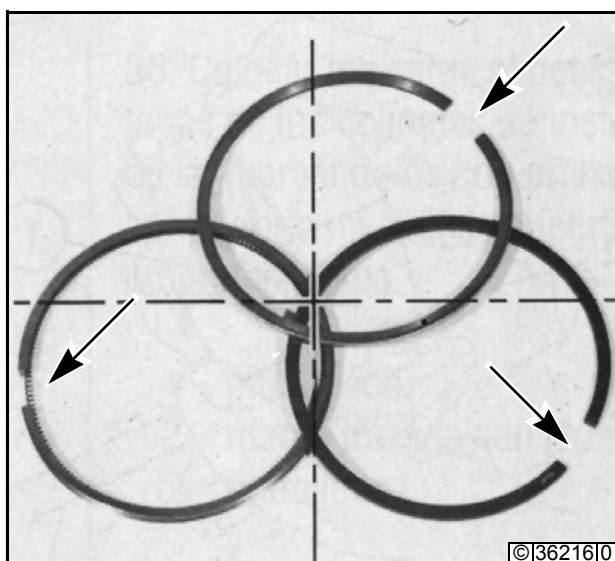




- Turn engine by 90°. Remove the cylinder retainer. Pull out cylinder together with the piston.
- Lay down parts in the order they were disassembled.



- Remove circlips.
- Take out piston pin.



#### **Refit piston and cylinder**

- Arrange piston ring gaps at an offset to each other of approx. 120°.

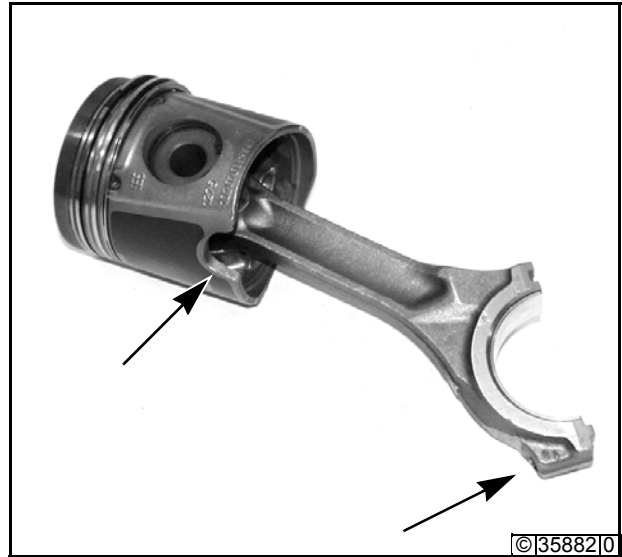
- Insert one circlip.



### Insert one circlip.

When assembling the piston and connecting rod, ensure that the recess for the oil spray nozzle in the piston and the long parting face of the connecting rod big end are located on the same side.

- Refit piston with connecting rod.



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- Insert second circlip.



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### Note

Lightly oil cylinder running surface.

- Tension piston rings with piston ring tensioning belt and slide the piston complete together with connecting rod into the cylinder.

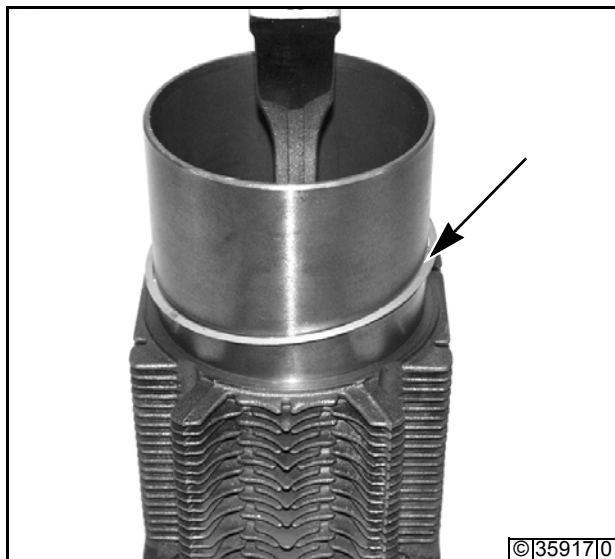


### Note

When refitting the piston and connecting rod, ensure that the arrow on the piston crown points to the exhaust end.



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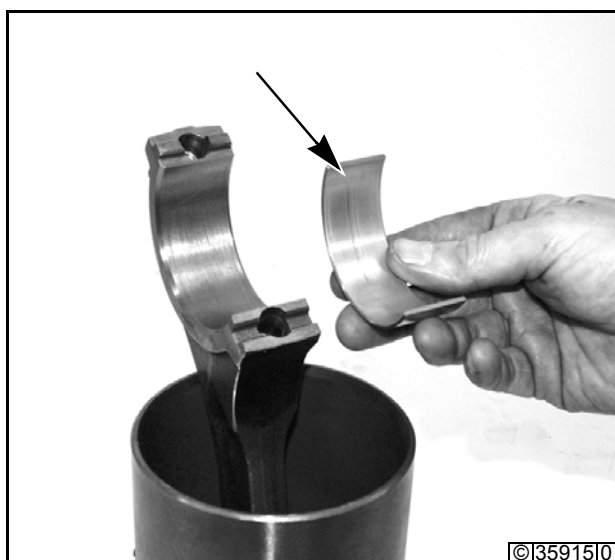


- Place on shim.



**Note**

A maximum of 3 shims with a total thickness of 1.5 mm is permissible.

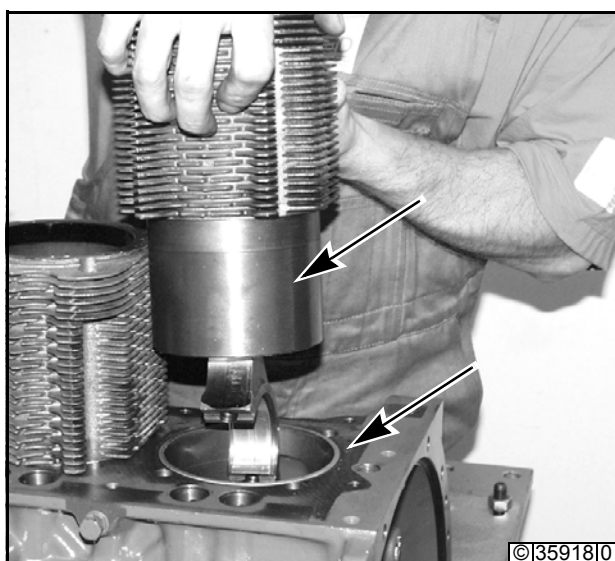


- Guide big end bearing shell into big end bearing cap



**Note**

Ensure that connecting rod matches the cap.



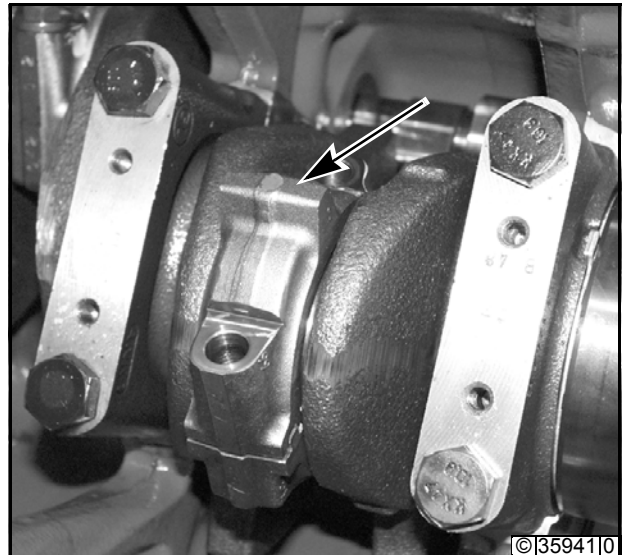
- Insert cylinder unit carefully as far as it will go.
- Secure cylinder so that it cannot fall out.



- Turn engine by 90°.
- Guide big end bearing shell into big end bearing cap.



- Place big end bearing cap with big end bearing shell on crankpin.

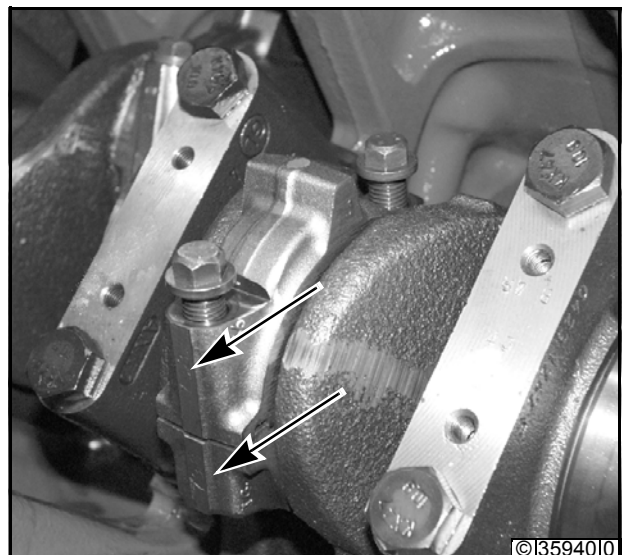


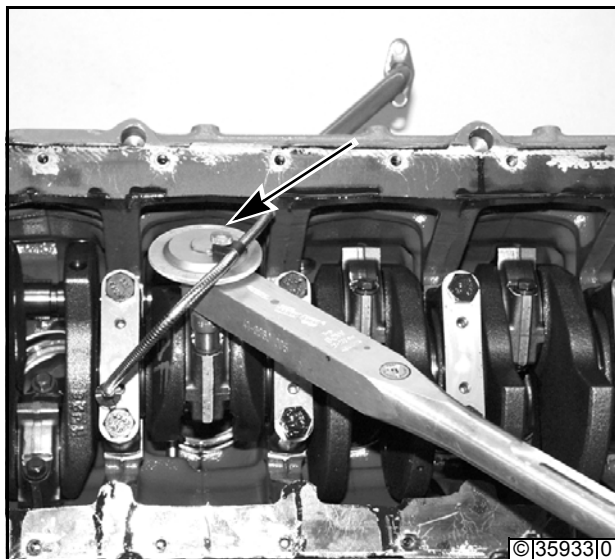
- Press connecting rod carefully against crankpin.



**Note**

Pay attention to numbering.





- Fit big end bearing cap with **new** con rod bolts and tighten.



- Refit oil pan  
- see work card **W 8-4-6**.
- Refit cylinder head  
- see work card **W 1-4-4**.

## Checking the cylinder



### Tools

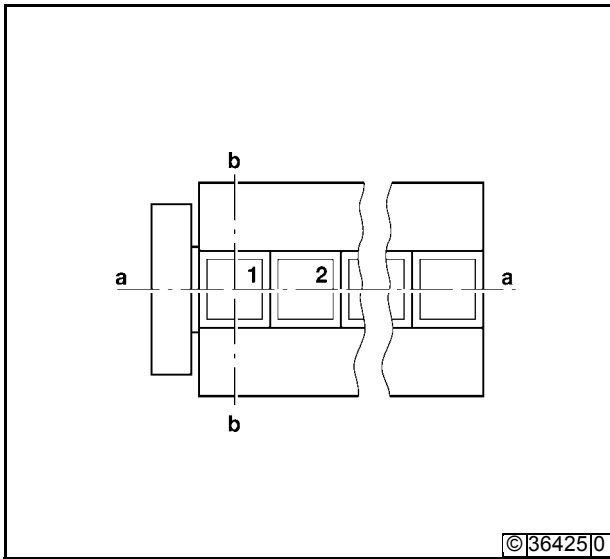
- Commercial tools
  - Internal dial gauge
  - External micrometer
- Special tools
  - Dial gauge \_\_\_\_\_ 100 400

- Set internal dial gauge.

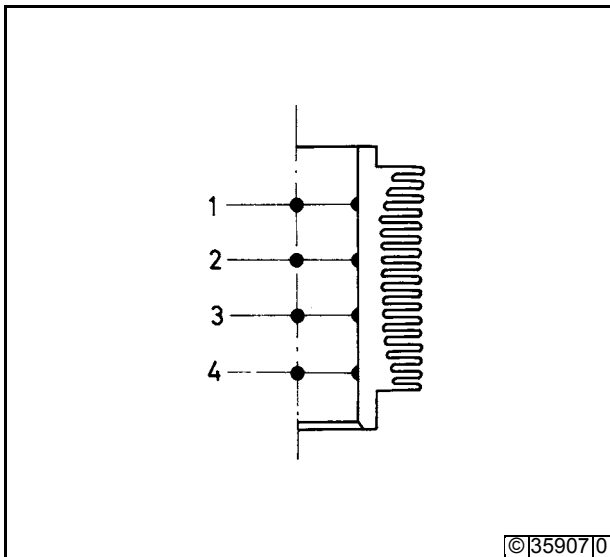


- Clean cylinder and visually inspect for damage.
- Gauge cylinder:





-in the engine's longitudinal axis "a" and traverse axis "b"



- and in planes 1 - 4



- Inspect upper seating surface of cylinder for damage.



### Note

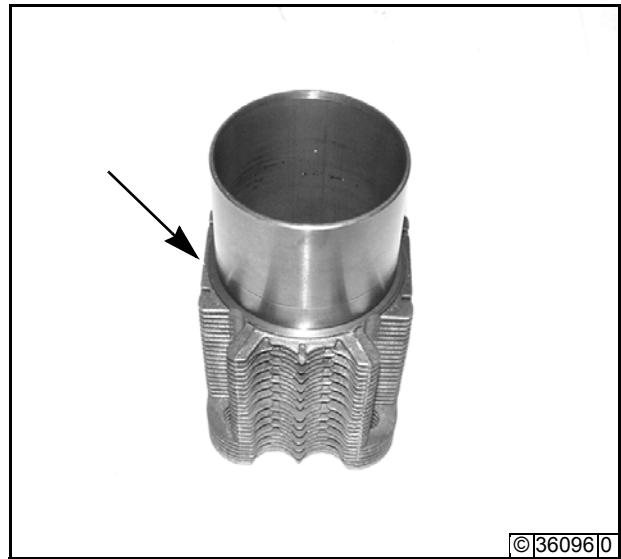
The surfaces must be clean and even.  
If damaged, replace as necessary.



- Inspect lower seating surface of cylinder for damage.

**Note**

The surfaces must be clean and even. If damaged, replace as necessary .



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**Removing and refitting the front cover (opposite end to coupling)****Tools**

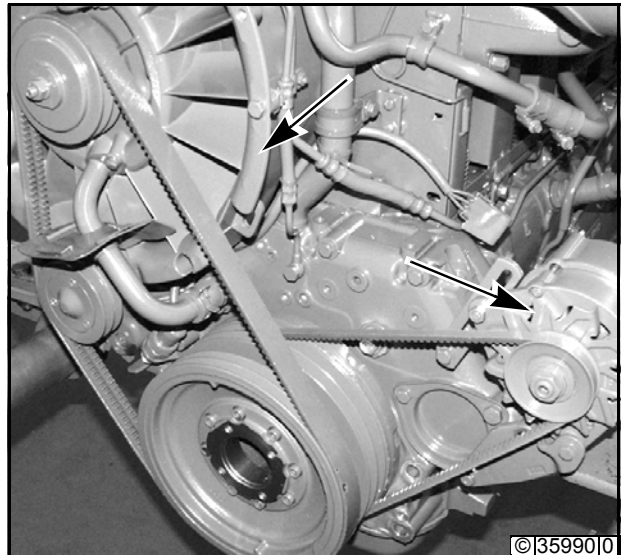
- Commercial tools
- Special tools
- Assembly device \_\_\_\_\_ 142 060

**References**

- W 9-11-1
- W 12-1-4
- W 13-2-3

**Remove front cover**

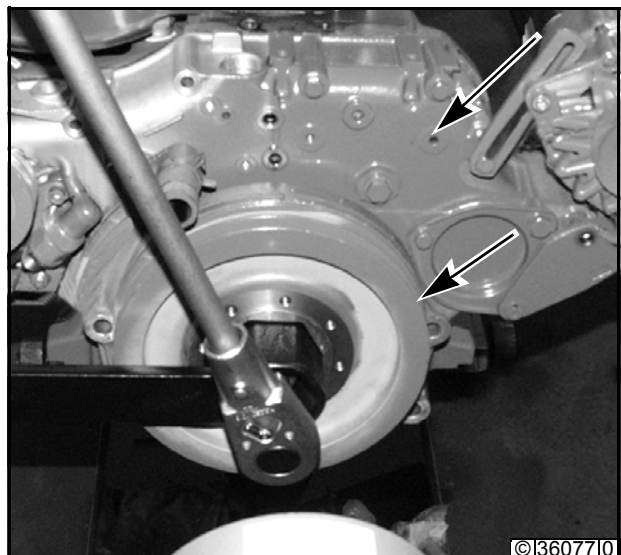
- Remove blower
  - see work card **W 9-11-1**.
- Remove three-phase alternator and support
  - see work card **W 13-2-3**.

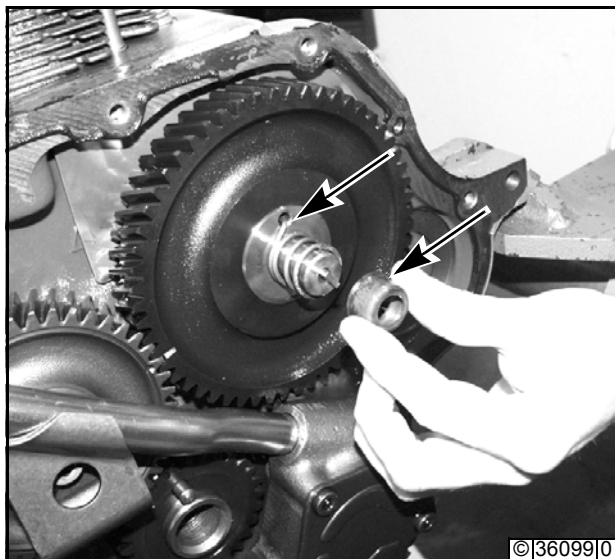


- Remove rotary vibration damper
  - see work card **W 12-1-4**.
- Remove front cover.

**Note**

Pay attention to compression spring and cap for camshaft.





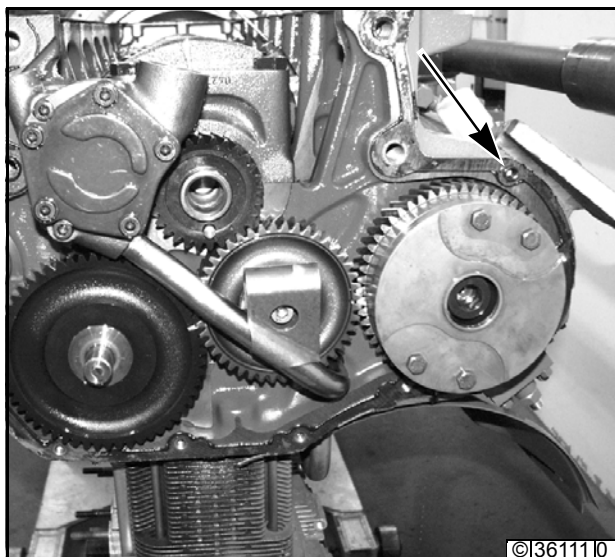
**Install front cover**

- Slide on compression spring and cap.



**Note**

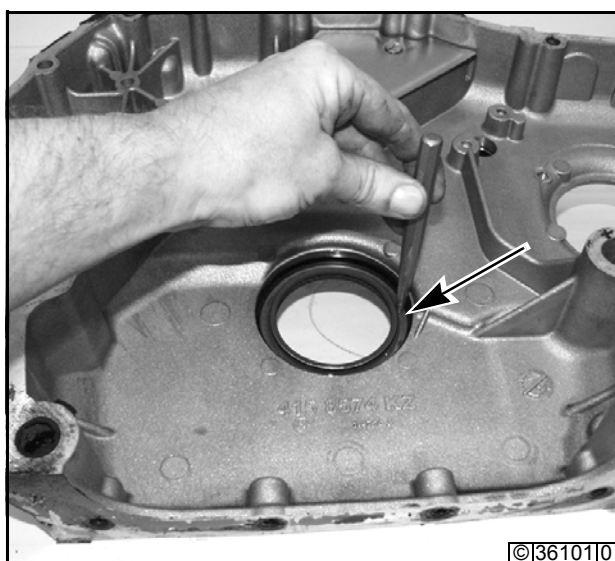
Introduce angled spring end into bore of camshaft.



**Note**

Engine is turned by 180°.

- Ensure that clamping bushes are fitted.

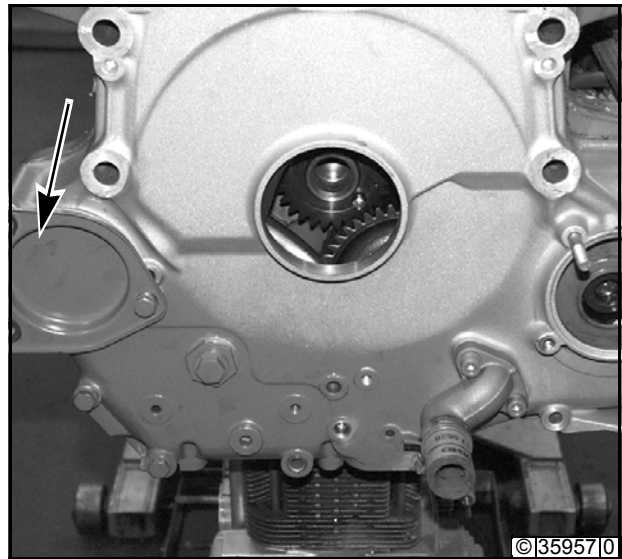


- Force out crankshaft seal.
- Clean sealing surfaces.

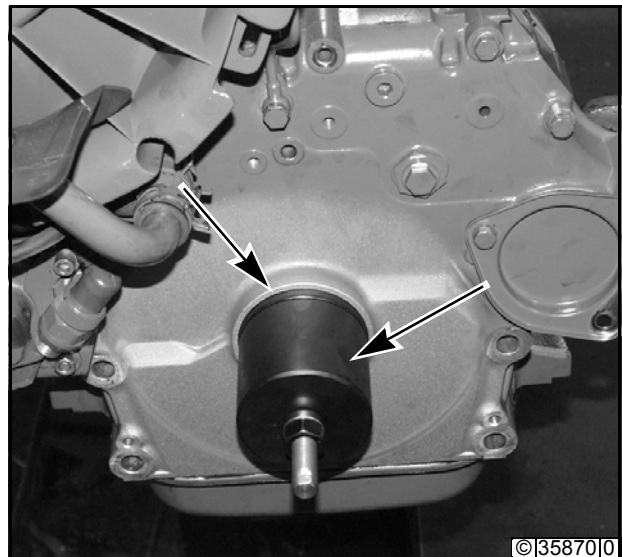
- Refit front cover with new seal. Tighten bolts.



- Refit cover with new sealing ring. Tighten bolts.



- Renew crankshaft seal (opposite end to coupling) of complete engine  
- see work card **W 2-2-4**.



- Refit rotary vibration damper  
- see work card **W 12-1-4**.
- Refit blower  
- see work card **W 9-11-1**.
- Refit three-phase alternator and support  
- see work card **W 13-2-3**.



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**Removing and refitting the rear cover (coupling end)****Tools**

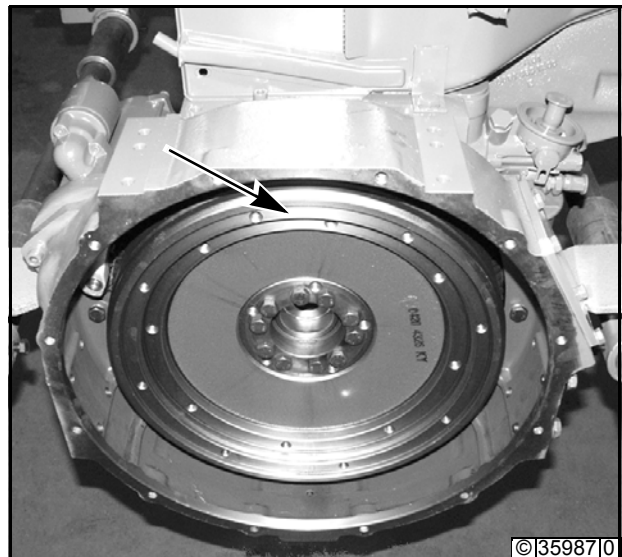
- Commercial tools
- Knife-edged ruler
- Special tools
- Retainer plate \_\_\_\_\_ 142 070
- Assembly device \_\_\_\_\_ 142 080
- Centering device \_\_\_\_\_ 143 110

**References**

- W 8-4-7
- W 12-6-1

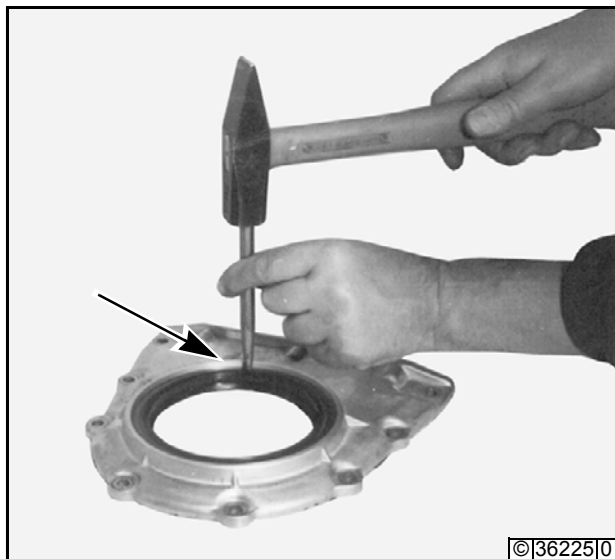
**Remove rear cover**

- Remove flywheel
  - see work card **W 12-6-1**.
- Remove oil pan
  - see work card **W 8-4-7**.

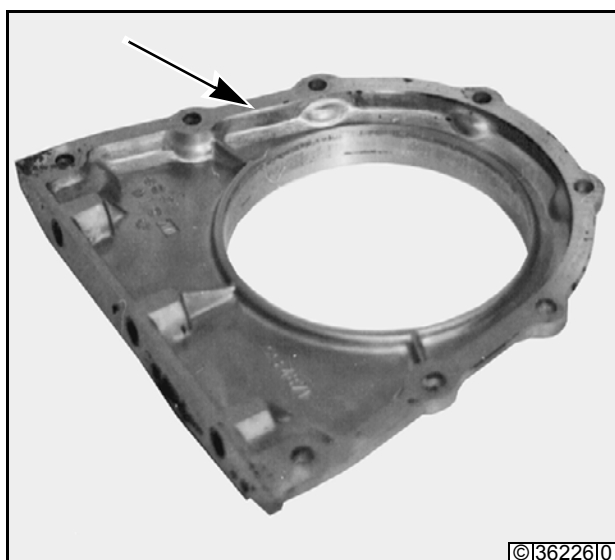


- Remove rear cover.

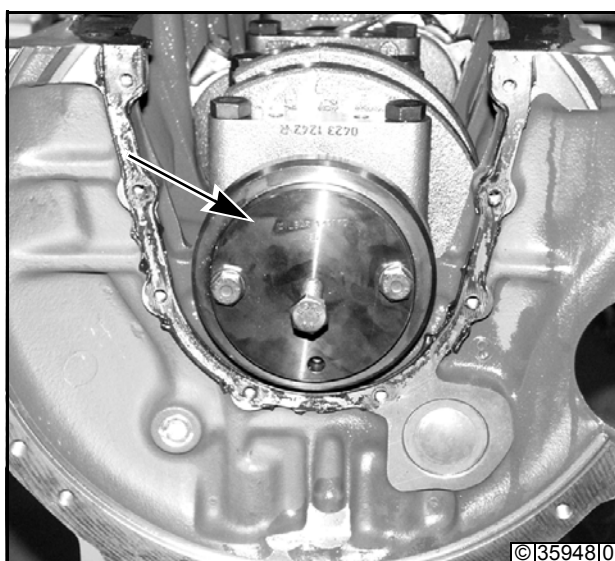




- Force out crankshaft seal.



- Visually inspect cover, replace if necessary.
- Remove sealing residues.

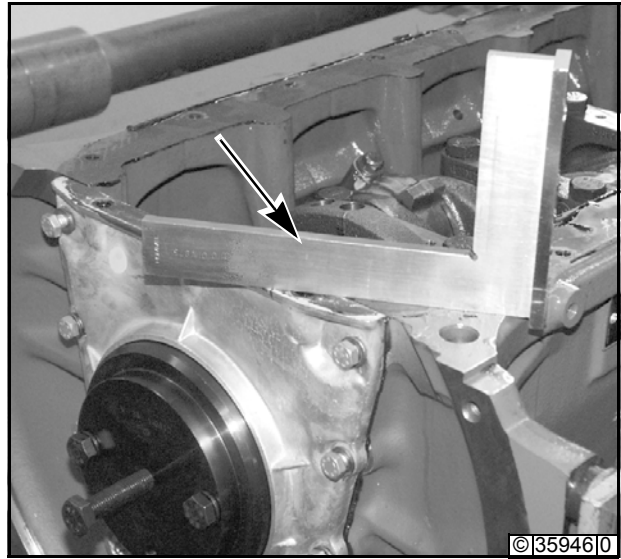


#### **Fit rear cover**

- Fit centering device. Tighten bolts lightly.



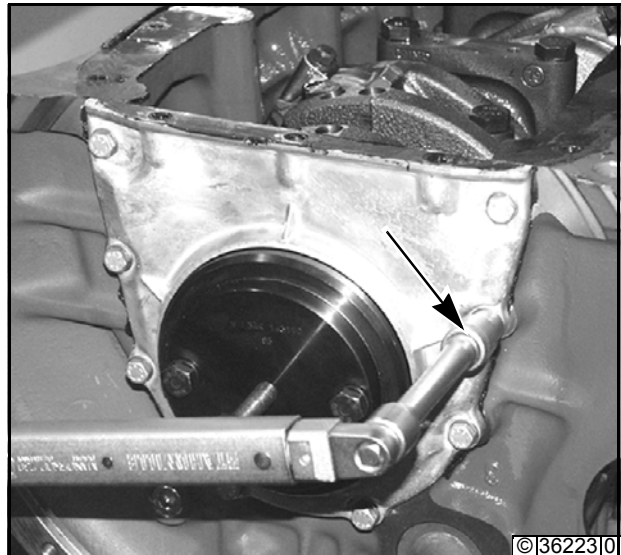
- Mount cover with new gasket and align.



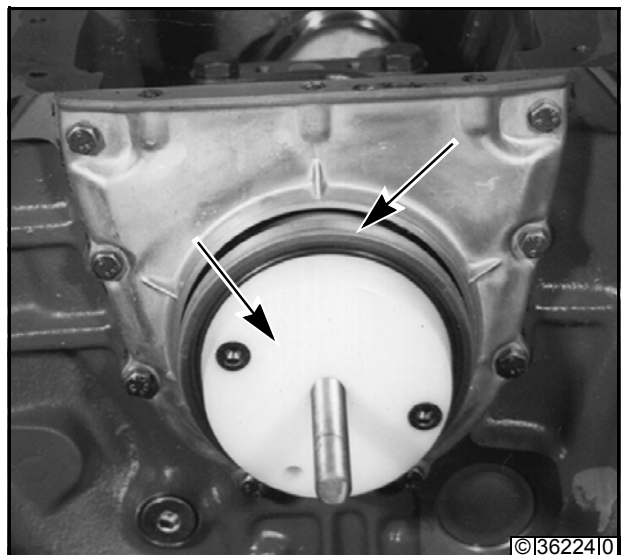
- Tighten bolts.

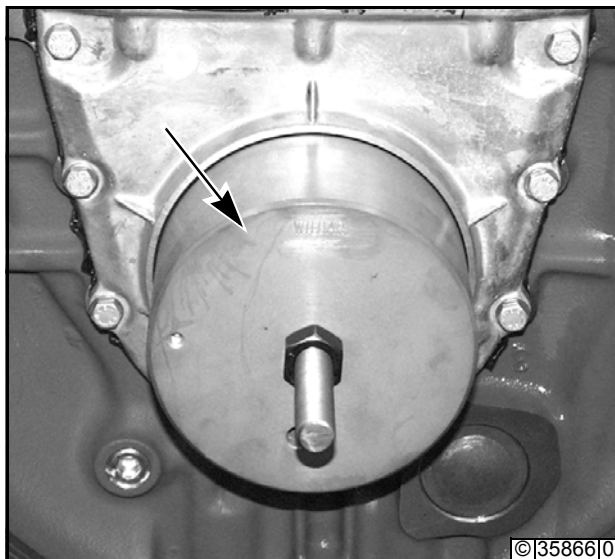


- Remove centering device.



- Fit guide bush.
- Lightly oil sealing lip and place new shaft seal onto guide bush.
- Sealing lip faces crankshaft.





- Fit shaft seal with assembly device.
- Observe installation depth. See marking on the special tool.



**Note**

Installation depth possibilities:

Installation depth 0:

Standard dimension with perfect shaft seal running surface.

Installation depth 1:

Offset installation with existing run-in groove on shaft seal running surface.



- Refit flywheel  
- see work card **W 12-6-1**.
- Refit oil pan  
- see work card **W 8-4-7**.

## Removing and refitting the adapter housing

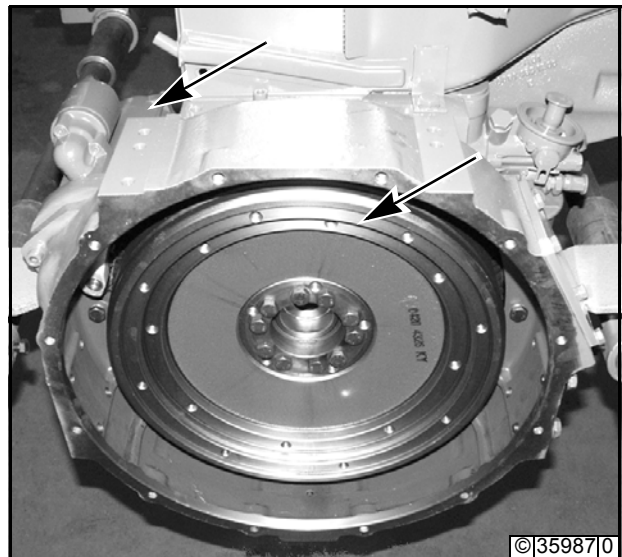


### Tools

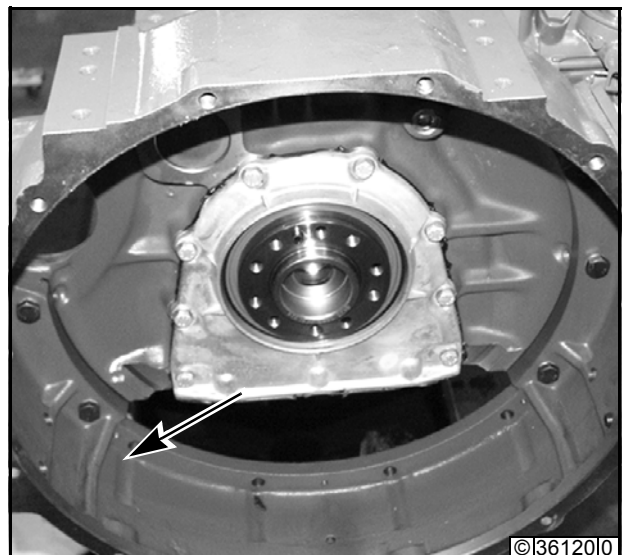
- Commercial tools
  - Special tools
- Tightening angle dial indicator \_ 101 910

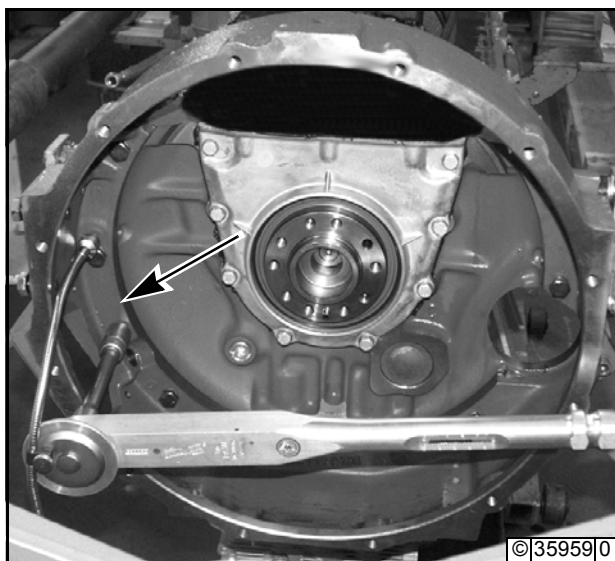
### Remove adapter housing

- Remove starter.
- Remove flywheel.



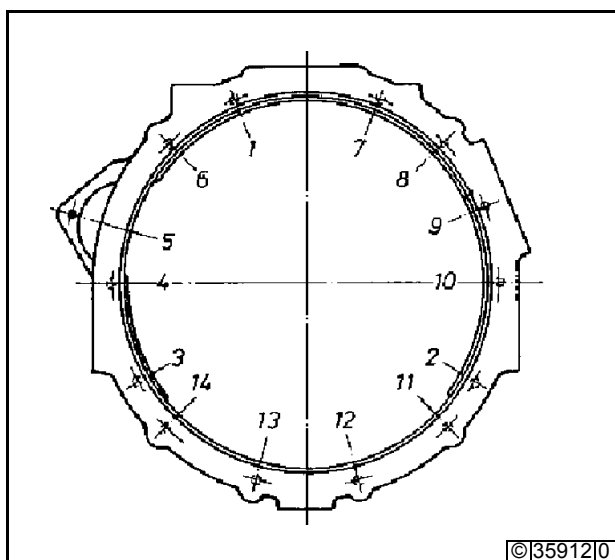
- Remove adapter housing.





**Refit adapter housing**

- Refit adapter housing. Tighten bolts according to the tightening schematic.



- Tightening schematic for adapter housing.



- Refit flywheel.



- Refit starter.





## Reworking the crankcase



### Tools

- Commercial tools
- Internal dial gauge
- Special tools
- Dial gauge \_\_\_\_\_ 100 400
- Press-in device \_\_\_\_\_ 143 610
- Assembly device
- for camshaft bush \_\_\_\_\_ 143 630
- Re-facing device \_\_\_\_\_ 150 020
- Device for oil spray nozzles \_\_\_\_ 151 100



### References

- W 2-4-1
- W 4-5-5
- W 7-4-1

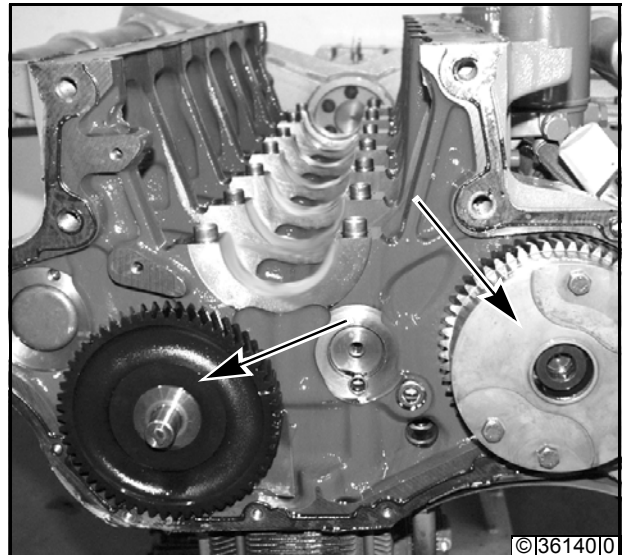
### Remove oil spray nozzles

- Remove crankshaft
  - see work card **W 2-4-1**.
- Remove camshaft
  - see work card **W 4-5-5**.
- Remove Injection pump
  - see work card **W 7-4-1**.
- Clean crankcase and visually inspect for damage.



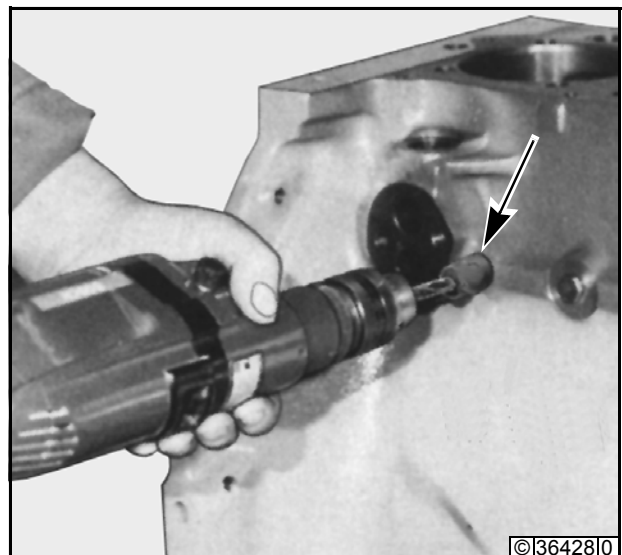
### Note

In case of traces of use in the bearing aisle, it is possible to rework the outer diameter to oversize in our Service Centers.

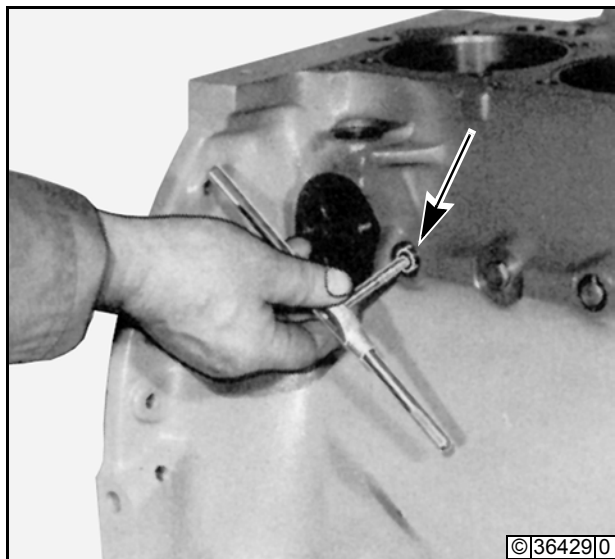


©36140|0

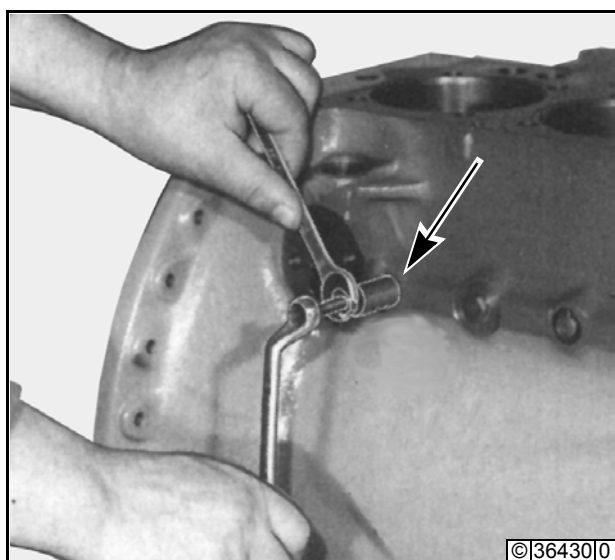
- Bring drill jig bush into position and drill max. 12 mm deep with 6.7 mm diameter drill.



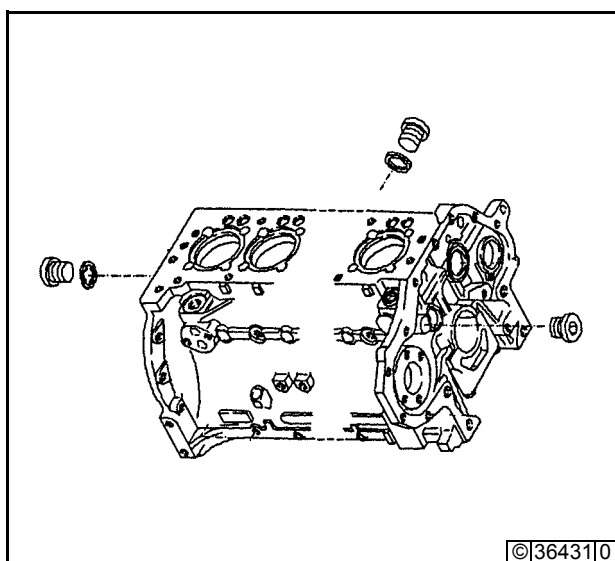
©36428|0



- Cut M 8 thread.

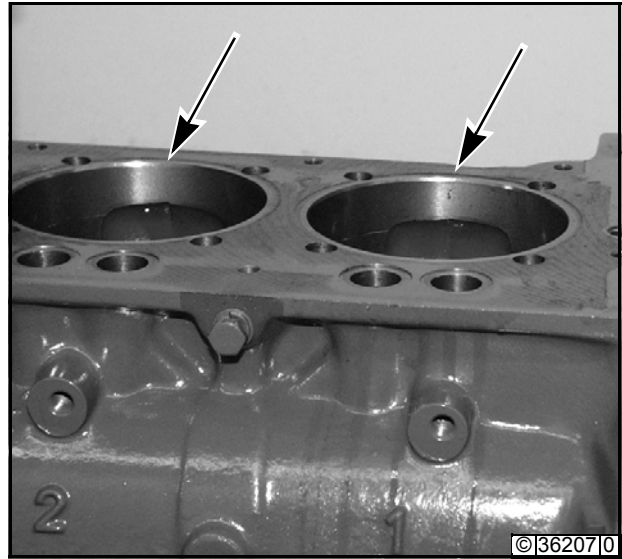


- Pull out oil spray nozzle with extracting bush.



- Remove oil screw plugs.
- Check oil ducts for free passage.

- Visually check cylinder seating surface on crankcase. Rework cylinder seating surfaces if necessary.



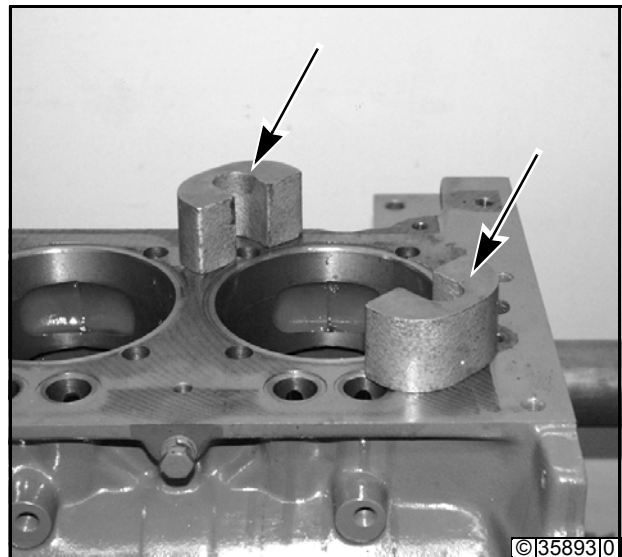
#### Rework cylinder seating surface

- Clean support brackets.
- Put small support brackets in place.

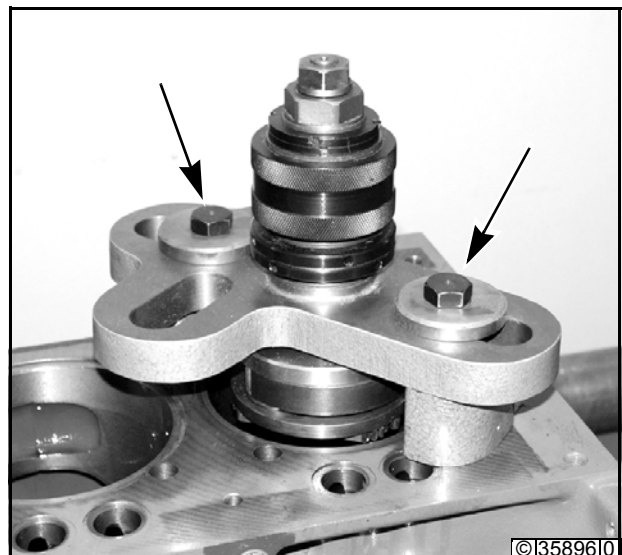


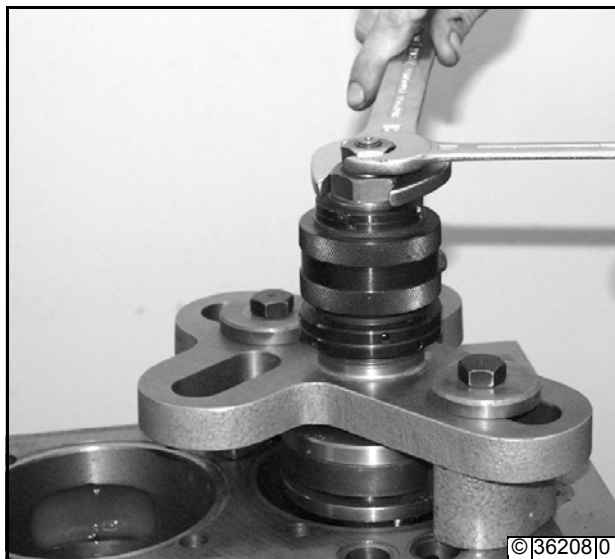
#### Note

Observe attached operation manual.

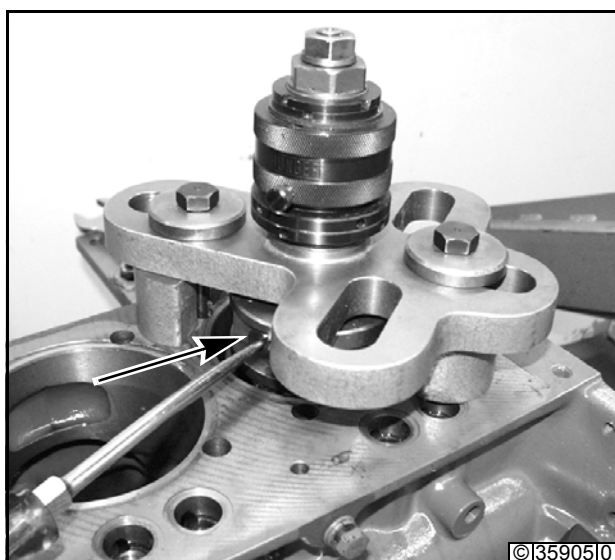


- Position re-facing device. Tighten bolts only to the extent that the support brackets and device can still be moved.

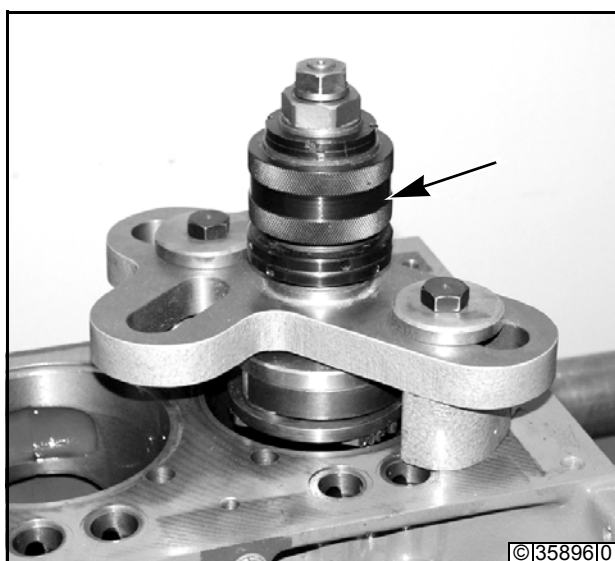




- Center re-facing device over the centering fingers tighten bolts.



- Withdraw centering fingers. Swing turning tool holder over the seating surface.



- Lower turret head by turning the knurled nut until the turning tool nearly touches the seating surface.

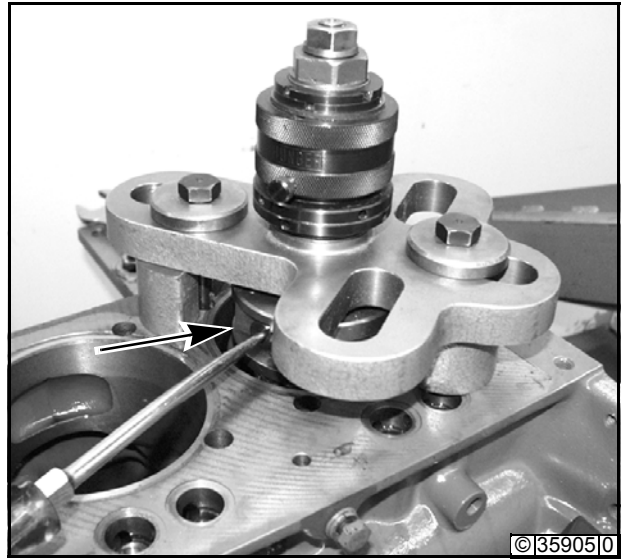


**Note**

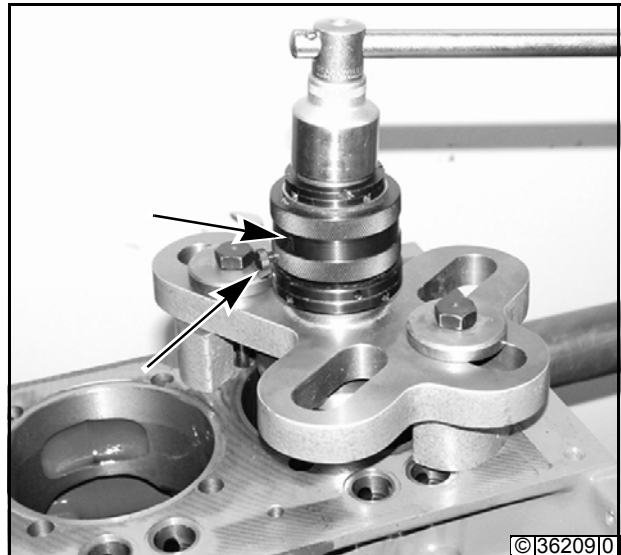
Feed carefully. With a full turn of the knurled nut (360°), the turning tool is fed by 1.5 mm.



- Swing tool holder to the inside by turning the square, until the tip of the turning tool is positioned just in front of the inner edge of the seating surface.



- Adjust cutting depth by turning the knurled nut to the right. Following adjustment, lock re-facing device with setscrew.
- Select cutting depth of 0.2 mm.

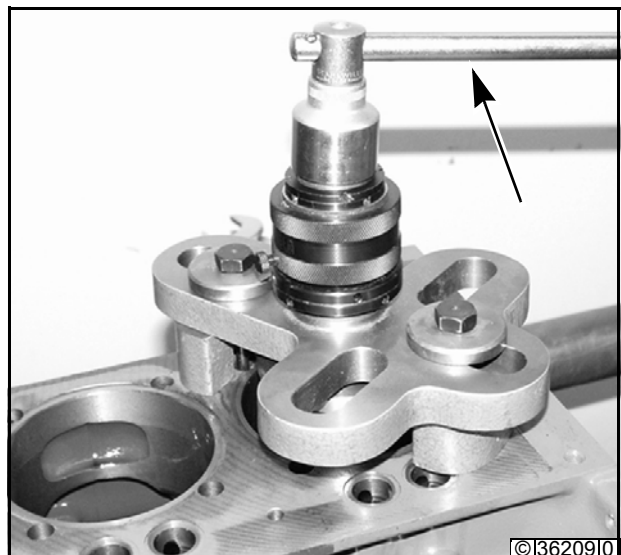


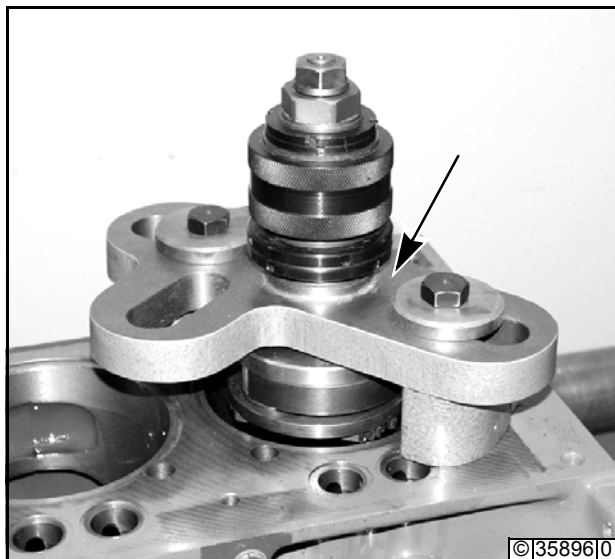
- Face seating surface by turning hand crank evenly.



## Note

Only remove enough material to obtain a perfect seating surface.



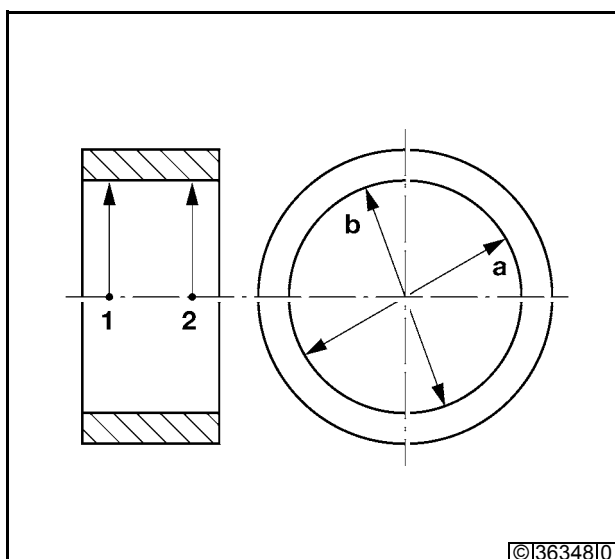


- Dismount re-facing device.



#### **Inspect camshaft bearing**

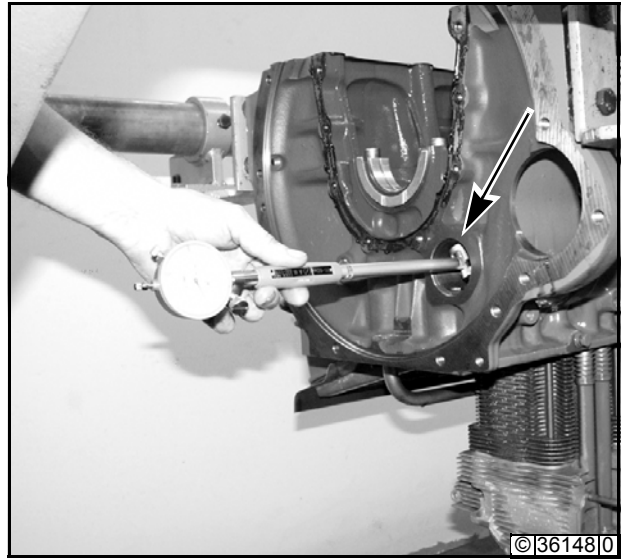
- Set internal dial gauge.



#### **Note**

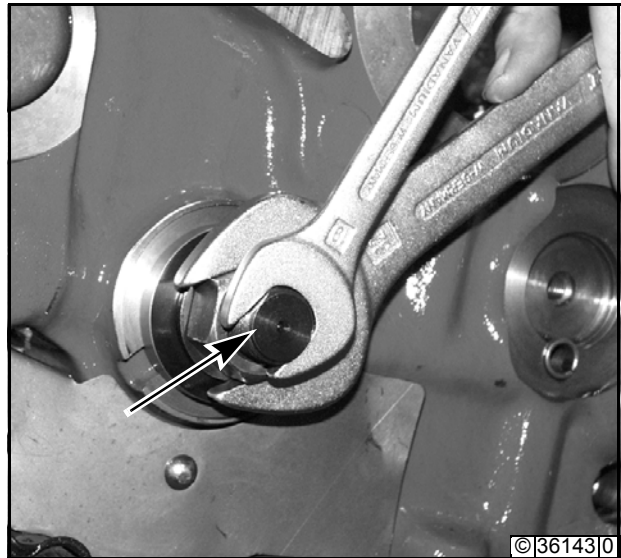
Schematic for gauging bearing bush and bearing bores at points 1 and 2 in planes "a" and "b".

- Gauge bearing bush, replace if necessary.



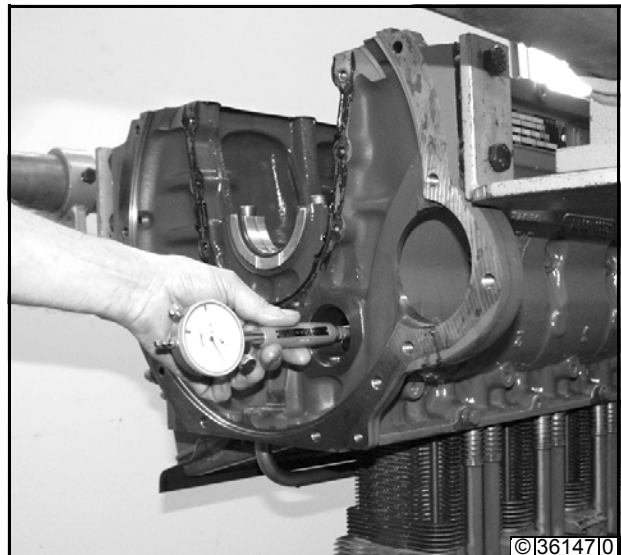
©36148|0

- Remove bearing bush with assembly device.



©36143|0

- Gauge bearing bores and inspect for visible damage, replace crankcase if necessary.



©36147|0

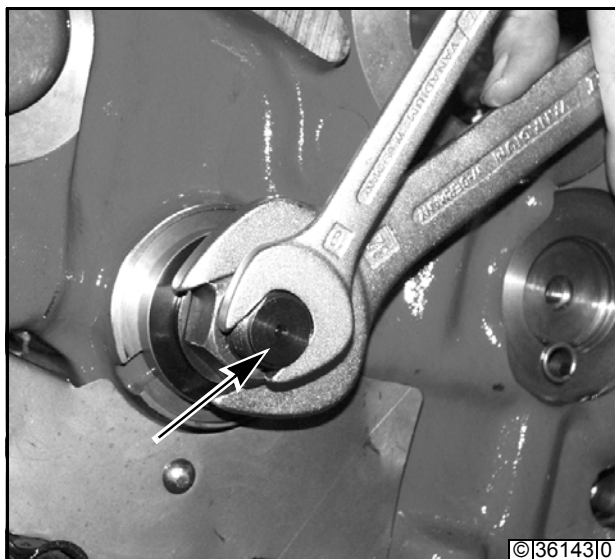


- Position new bearing bush in place.

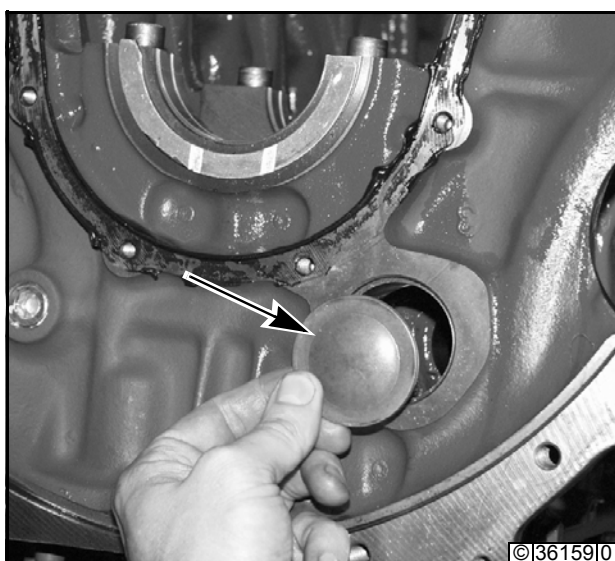


**Note**

Make sure that the oil bores are in line.



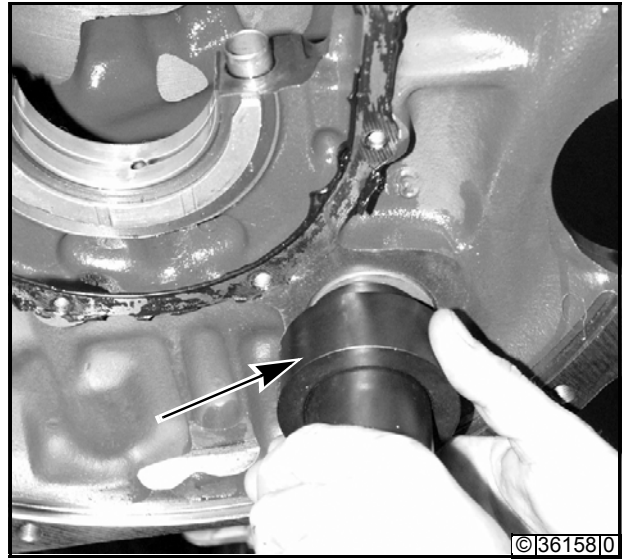
- Press bearing bush in flush with assembly device.



- Check cover for firm seat, replace if necessary.



- Upset new cover by hammer strokes using press-in device.

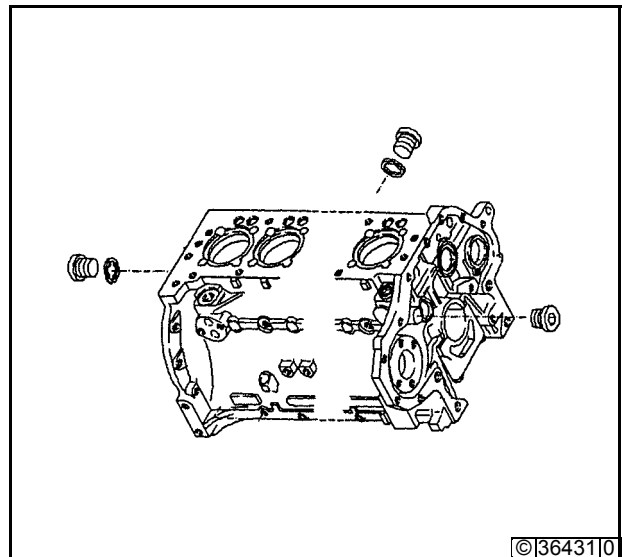


- Screw in all screw plugs and tighten.
  - Item 1 with new special sealing ring
  - Item 2 with new Cu sealing rings

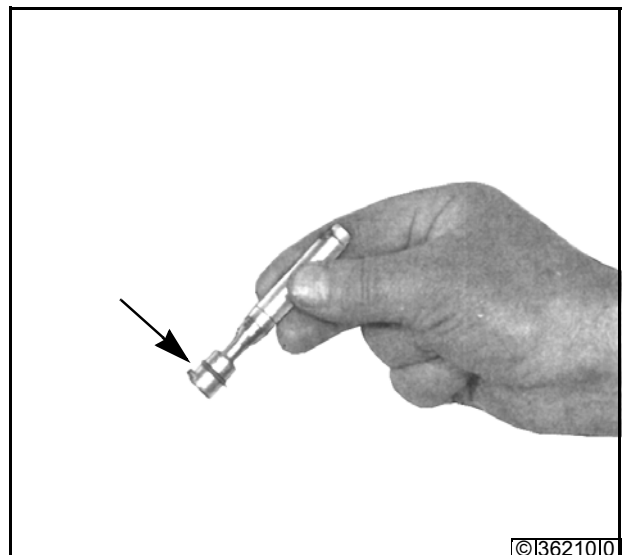


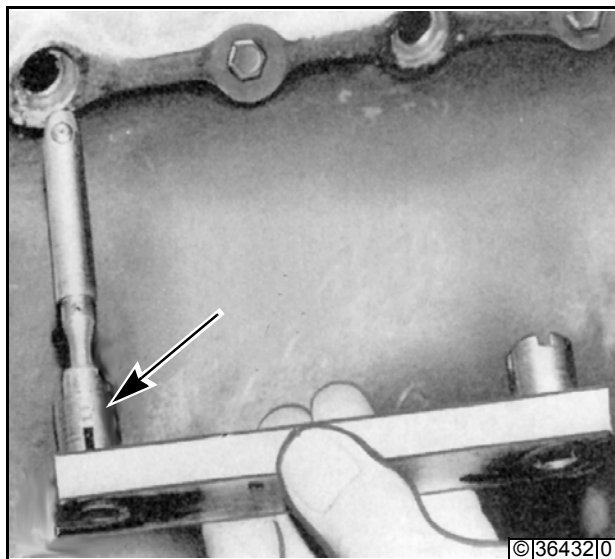
## Note

Screw plugs items 1 and 2 coated with sealing compound.  
Screw plugs coated with sealing compound must always be renewed after disassembly.



- Insert new O-ring seal and oil.
- Refit oil spray nozzle.



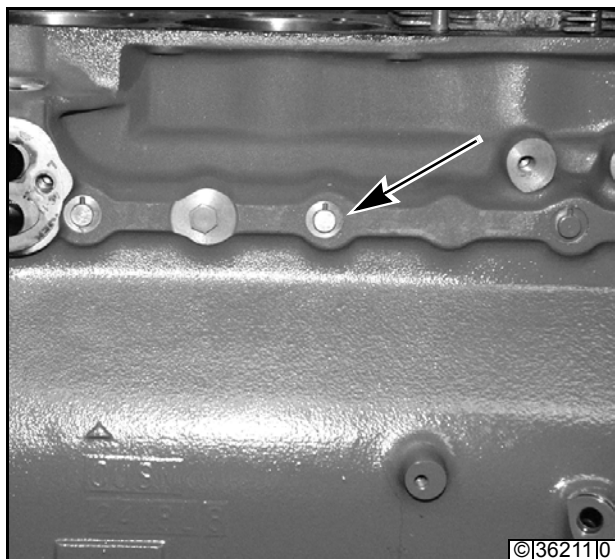


- Insert oil spray nozzle into the press-in device.



**Note**

Cylinder pin must point towards the cylinder seating surface.



- Refit oil spray nozzle, ensure that press-in tool is centered.

## Removing and refitting the injection pump intermediate gear

**Tools**

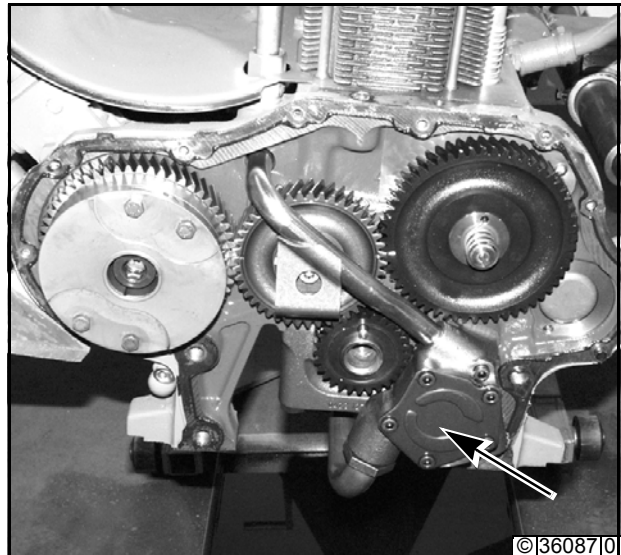
- Commercial tools

**References**

- W 3-8-1
- W 8-4-5
- W 9-11-1

### Remove injection pump intermediate gear

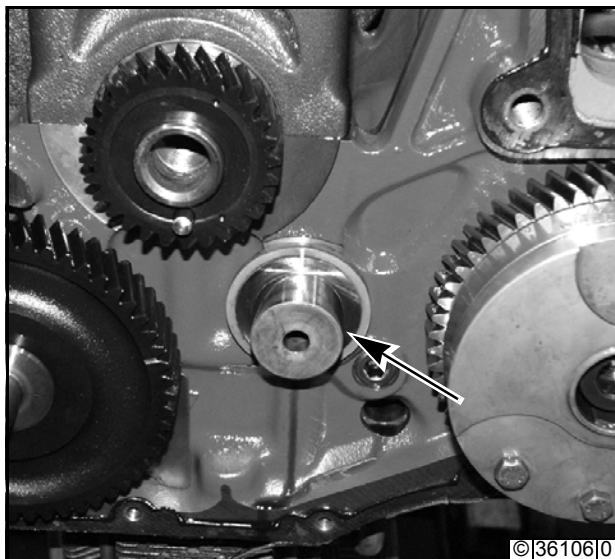
- Remove blower
  - see work card **W 9-11-1**.
- Remove front cover
  - see work card **W 3-8-1**.
- Remove oil pump with pressure-oil line
  - see work card **W 8-4-5**.

**Note**

Engine is turned through 180° in this picture.

- Remove intermediate gear with bearing journal.





#### Refit injection pump intermediate gear



##### Note

Engine is turned through 180° in this picture.

- Refit bearing journal.



##### Note

Ensure that dowel sleeve is fitted, insert if not.



##### Note

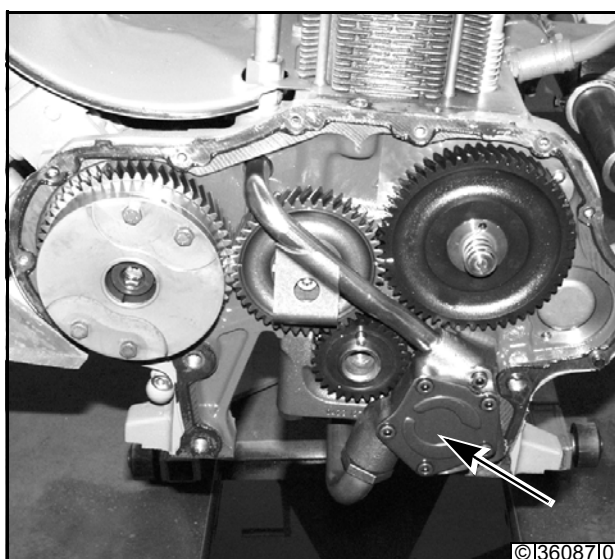
Engine is turned through 180° in this picture.

- Install the intermediate gear in such a way that the markings coincide.



##### Note

- These markings apply to 4, 5 and 6 cylinder engines.
- MAG is used for 4 cylinder engines. The arrow marking applies to MAG.
- There is a further marking (arrow) on the injection timing mechanism for 3 cylinder engines.



- Refit oil pump with pressure-oil line  
- see work card **W 8-4-5**.
- Refit front cover  
- see work card **W 3-8-1**.
- Refit blower  
- see work card **W 9-11-1**.



**Checking the injection pump intermediate gear****Tools**

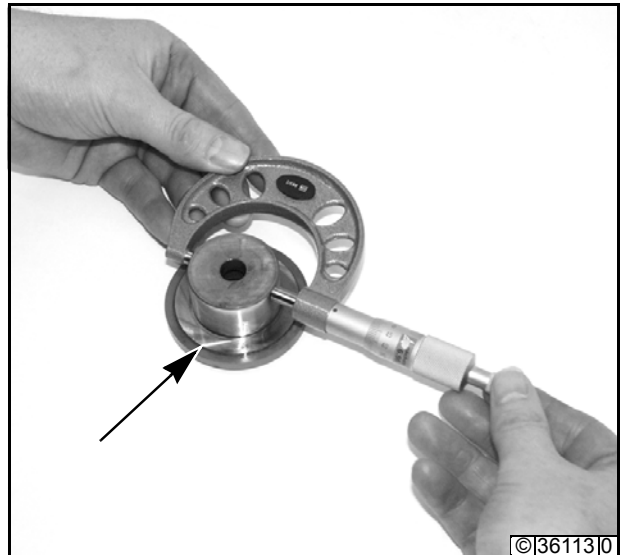
- Commercial tools
- External micrometer
- Special tools
- Dial gauge \_\_\_\_\_ 100 400

**References**

- W 4-4-7

**Check injection pump intermediate gear**

- Remove injection pump intermediate gear  
- see work card **W 4-4-7**.
- Visually inspect bearing journal and gauge.

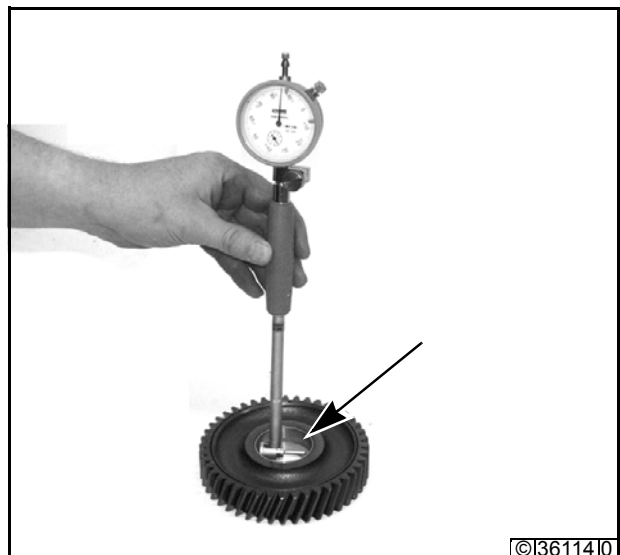


- Visually inspect intermediate gear and gauge bush.

**Note**

The bush is precision-bored in installed condition.

- Refit injection pump intermediate gear  
- see work card **W 4-4-7**.



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## Removing and refitting the camshaft



### Tools

- Commercial tools



### References

- W 1-2-2
- W 3-8-1
- W 8-4-5

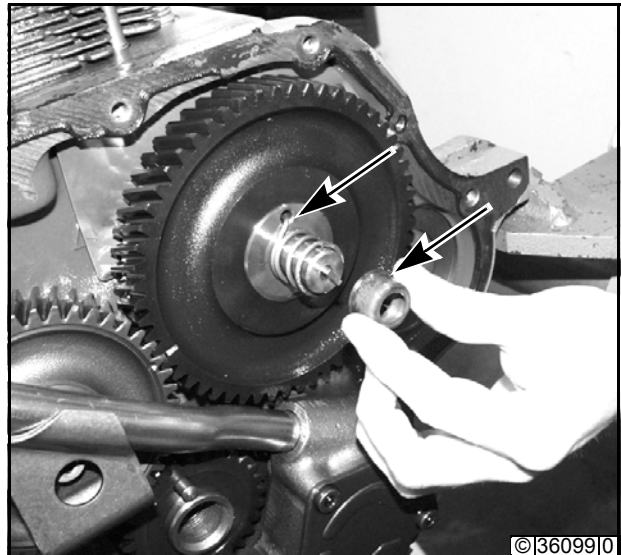


### Note

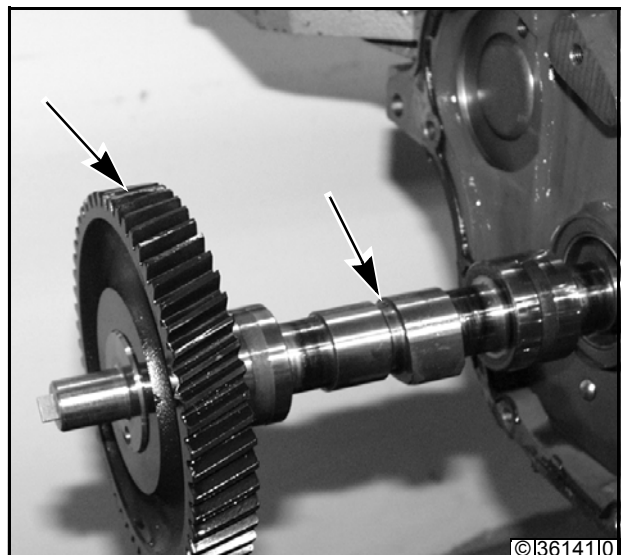
- The crankshaft is removed in this work process to give a clearer overview.

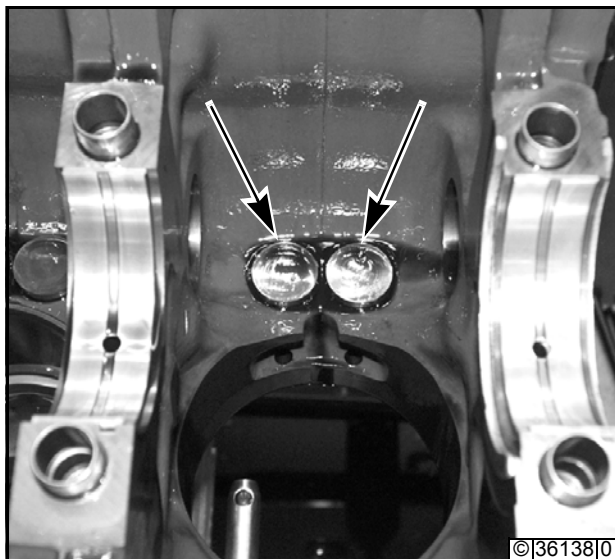
### Remove camshaft

- Set engine to firing TDC cylinder 1.
- Remove rocker arm and rocker arm bracket
  - see work card **W 1-2-2**.
- Remove push rods.
- Remove front cover
  - see work card **W 3-8-1**.
- Remove compression spring and cap.
- Remove oil pump
  - see work card **W 8-4-5**.

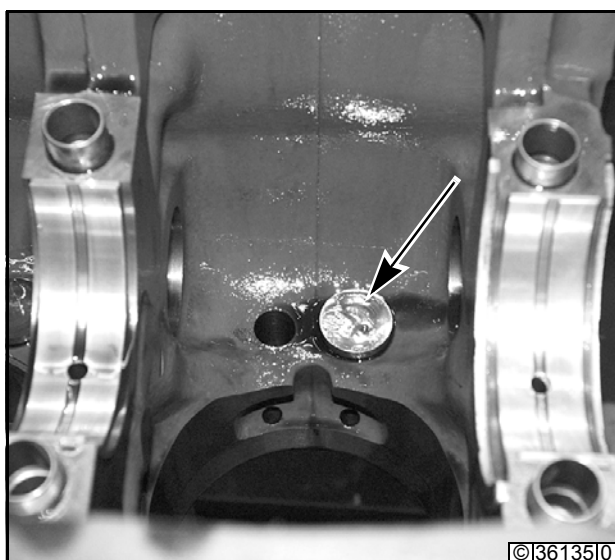


- Press down tappets.
- Take out camshaft.
- Remove gear and take off thrust ring.



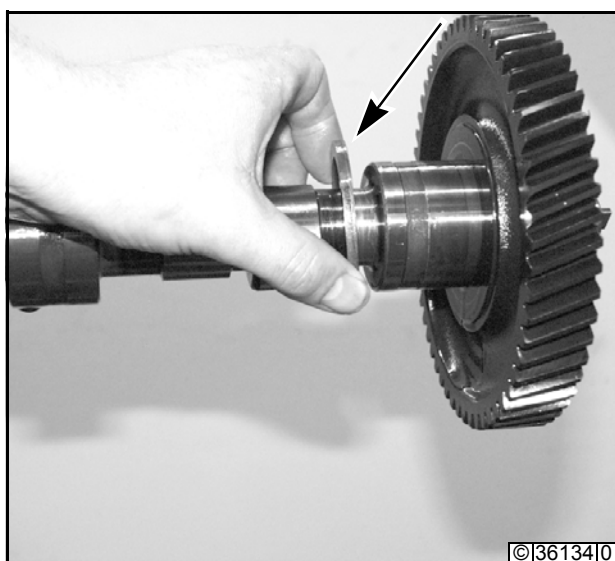


- Take out tappets and inspect visually.



**Refit camshaft**

- Insert tappets.



- Place thrust ring onto camshaft.

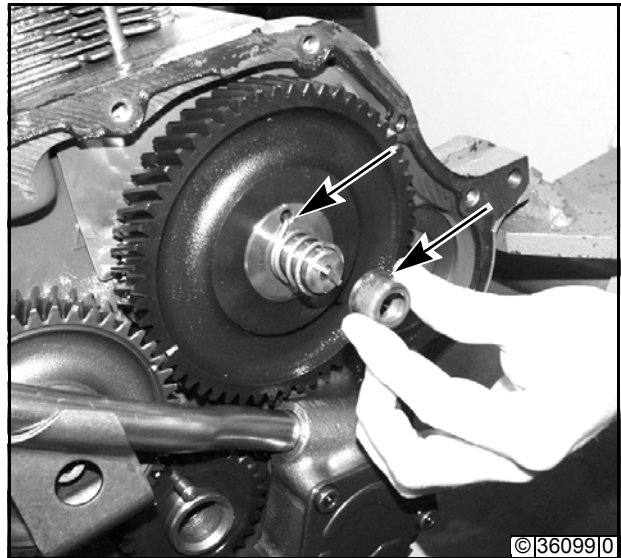
- Insert camshaft so that the markings coincide.

**Note**

Engine is turned through 180° here.



- Refit oil pump  
- see work card **W 8-4-5**.
- Refit compression spring and cap. Introduce angled spring end into bore of camshaft.
- Refit front cover  
- see work card **W 3-8-1**.
- Refit push rods.
- Refit Rocker arm und rocker arm bracket  
- see work card **W 1-2-2**.



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## Checking the camshaft

**Tools**

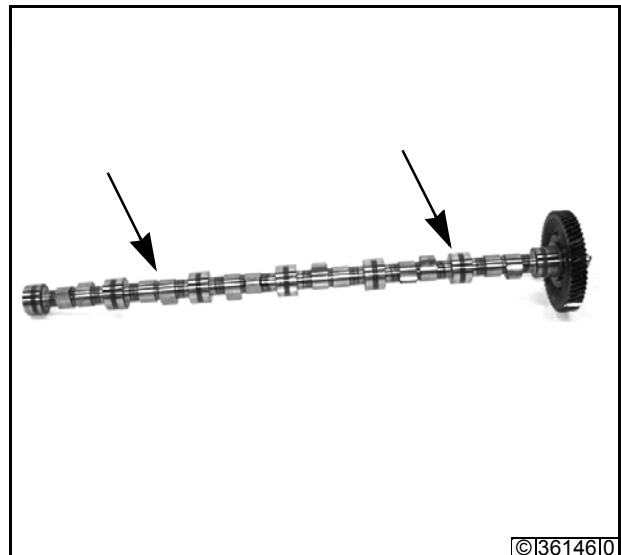
- Commercial tools

**References**

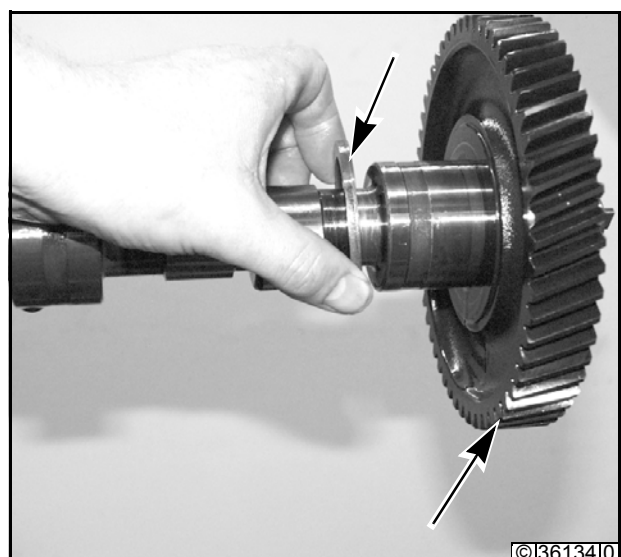
- W 4-5-5

**Check camshaft**

- Dismount camshaft  
- see work card **W 4-5-5**.
- Visually check cams, bearing journals and gear for wear, replace camshaft if necessary.



- Refit camshaft  
- see work card **W 4-5-5**.





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## Removing and remounting the exhaust manifold



### Tools

- Commercial tools

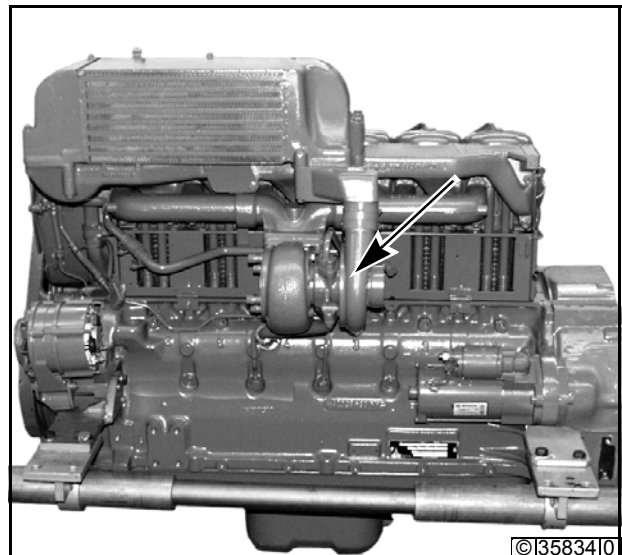


### References

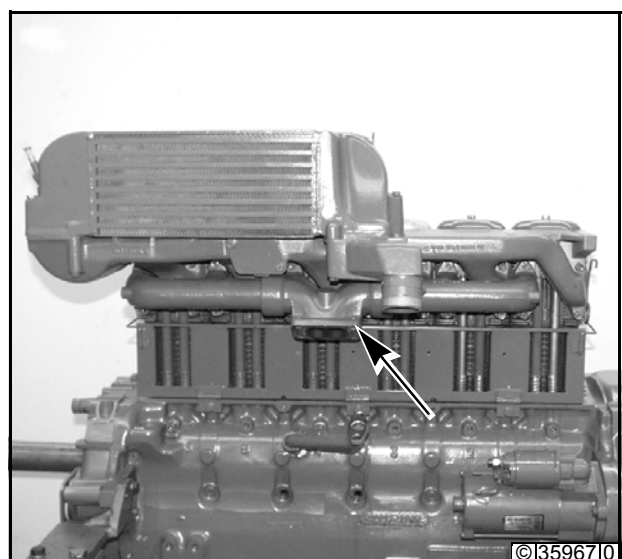
- W 6-6-4

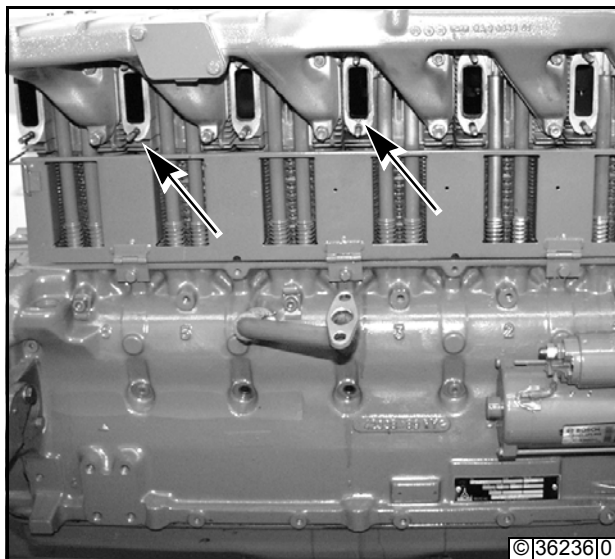
### Remove exhaust manifold

- Remove turbocharger  
- see work card **W 6-6-4**.



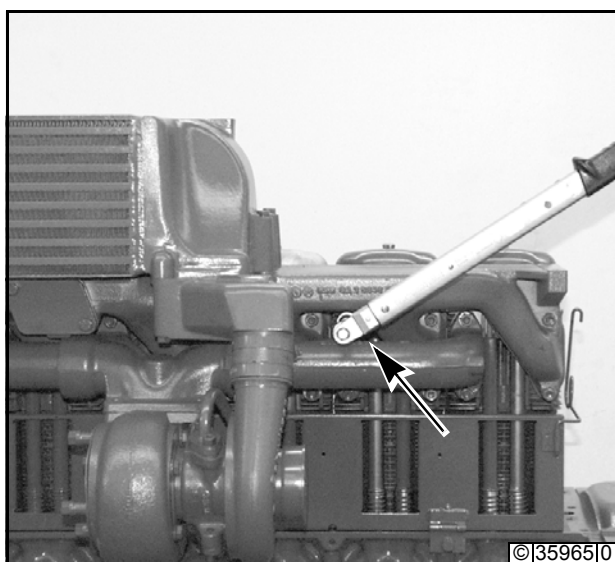
- Remove exhaust manifold.





**Refit exhaust manifold**

- Clean sealing surfaces.
- Fit new gaskets.



- Refit exhaust manifold.



**Note**

Tighten the exhaust manifold crosswise from the middle.

- Tighten hex nuts.



- Refit turbocharger  
- see work card **W 6-6-4**.  
Tighten bolts.



**Removing and remounting the turbocharger****Tools**

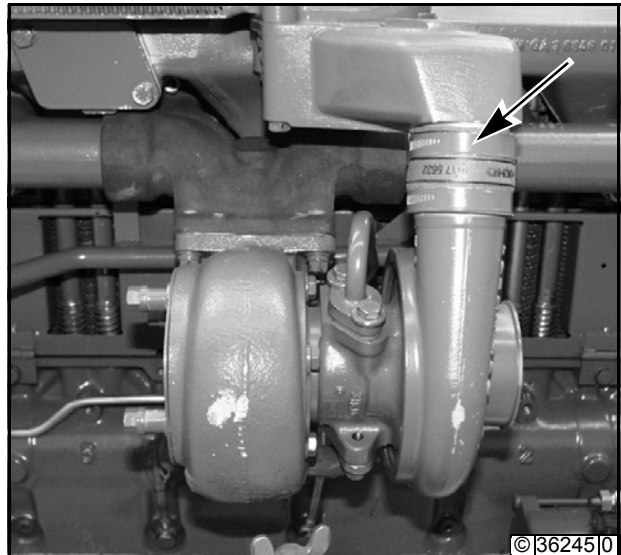
- Commercial tools
- Spring-loaded clamp pliers \_\_\_\_\_ 9090

**Auxiliary aids**

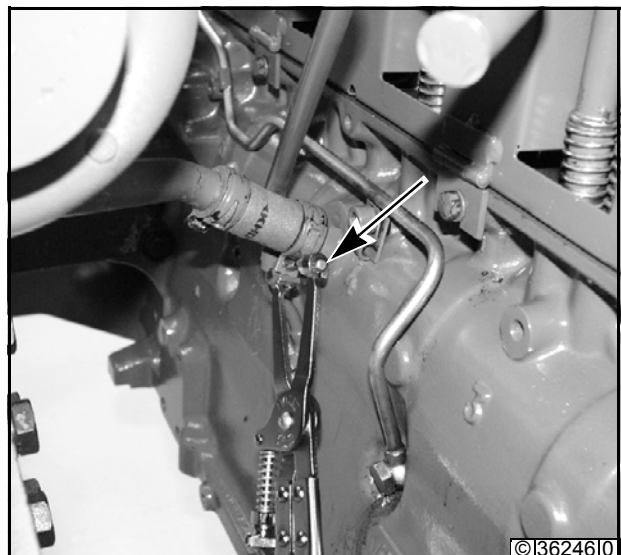
- DEUTZ S1

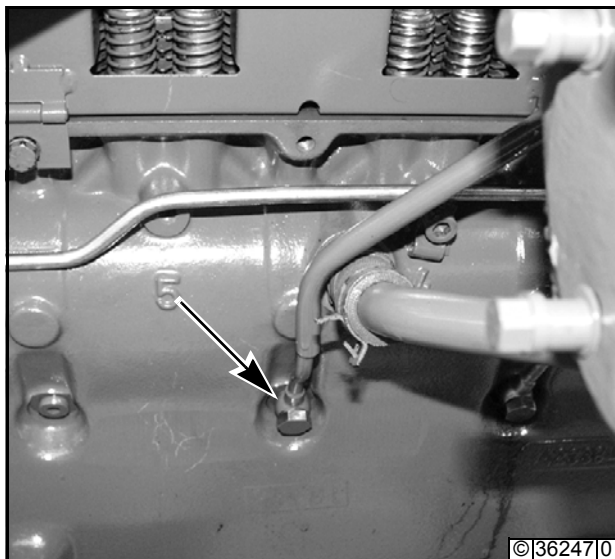
**Remove turbocharger**

- Undo hose clamp.

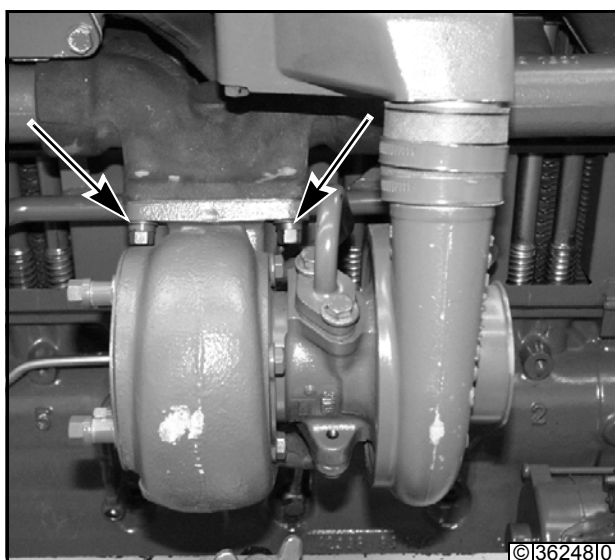


- Remove oil return line.
- Use spring-loaded clamp pliers.
- Catch escaping oil.

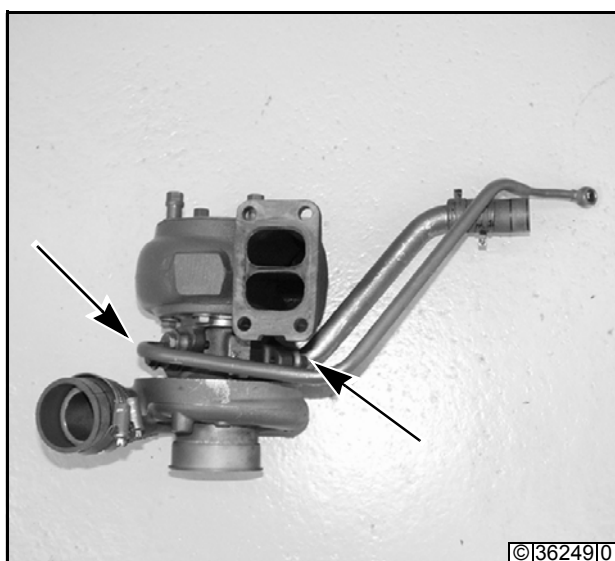




- Remove oil line.
- Catch escaping oil.



- Remove turbocharger.

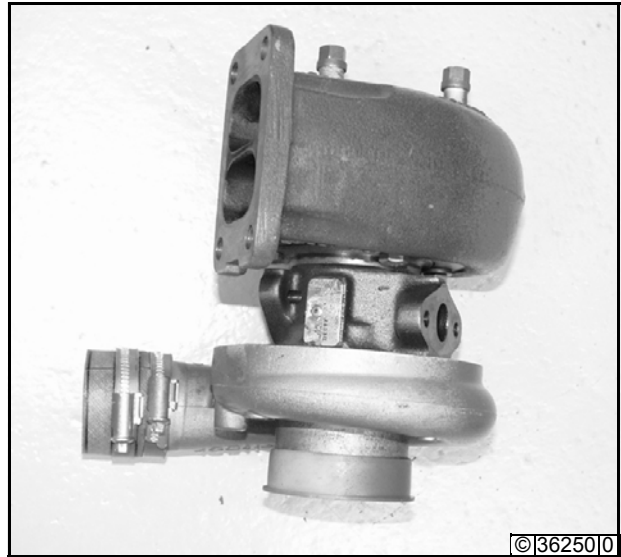


- Remove oil line and oil return line from turbocharger.

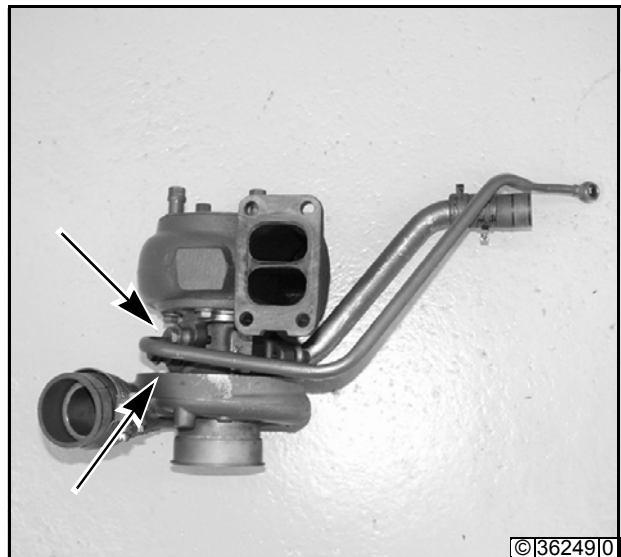
- Visually check turbocharger, replace if necessary.

**Note**

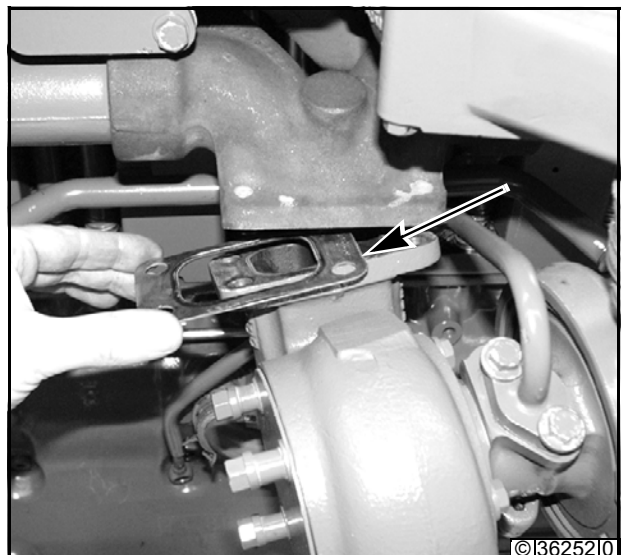
If the turbocharger is damaged / worn, it is possible to have it reconditioned at our Service Centers.

**Refit turbocharger**

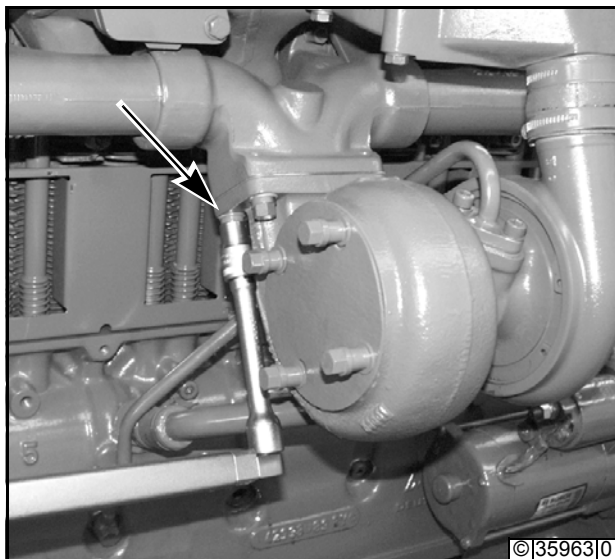
- Refit oil return line and oil line with new gasket.
- Coat oil line bolts with DEUTZ S1 fitting lubricant and tighten.



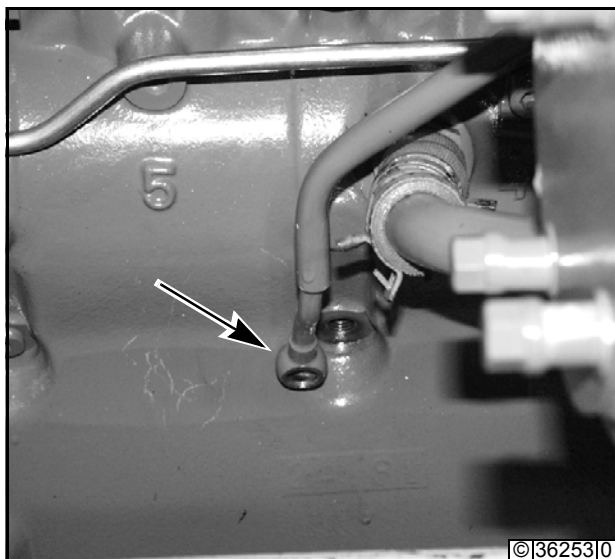
- Mount turbocharger with new gasket.



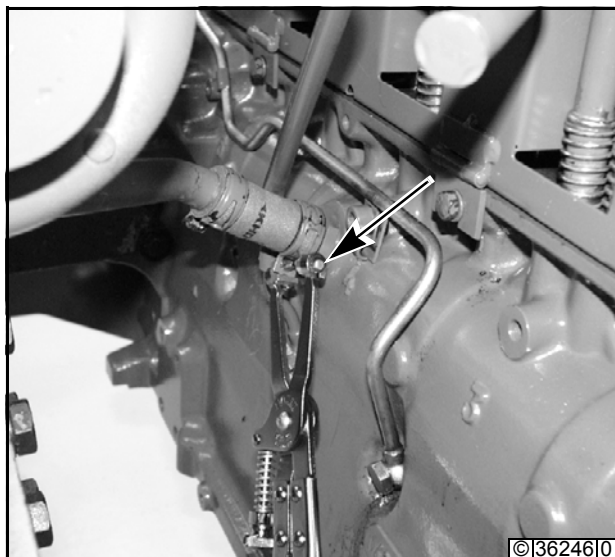




- Tighten bolts on turbocharger.



- Mount oil line with new Cu sealing rings and tighten.



- Mount oil return line.

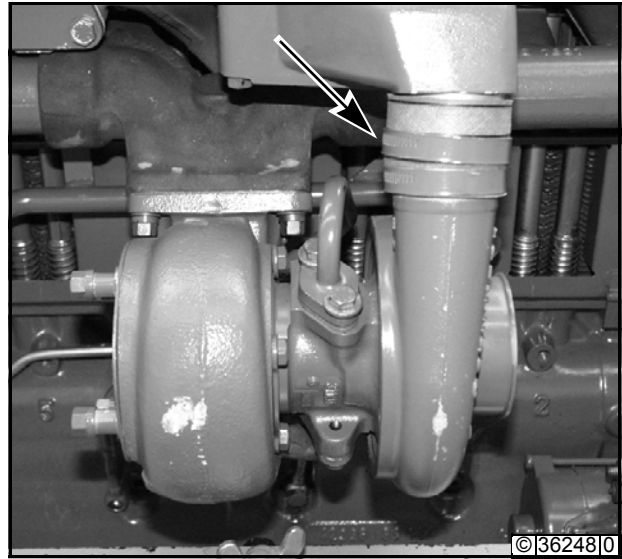


**Note**

Use spring-loaded clamp pliers.



- Use spring-loaded clamp pliers.
- Check oil level and replenish, if necessary.





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**Removing and refitting the air suction pipe****Tools**

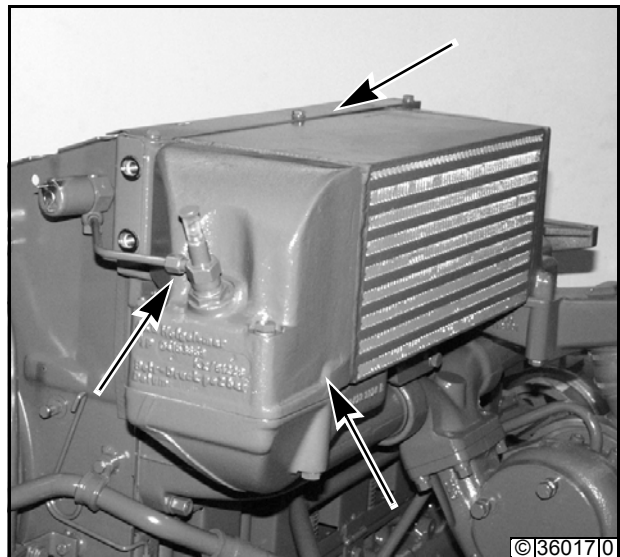
- Commercial tools

**References**

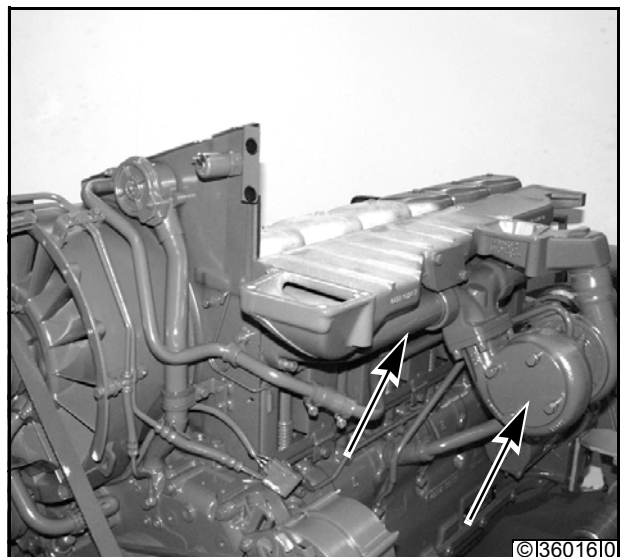
- W 6-1-5  
- W 9-11-3

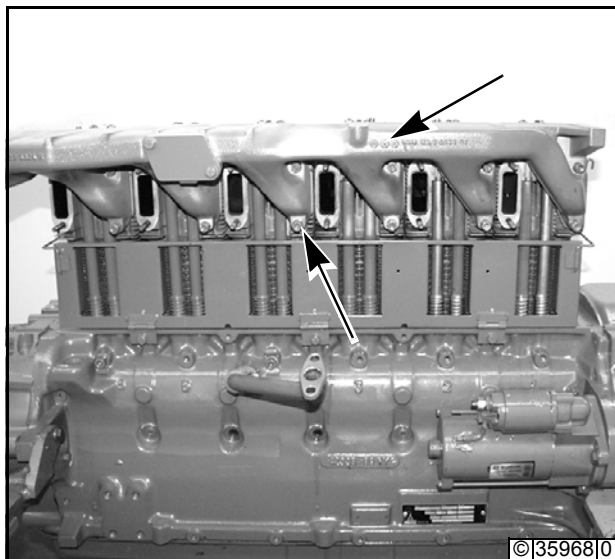
**Dismount air suction pipe**

- Dismount cooling air guide sheets  
- see work card **W 9-11-3**.
- Remove line.
- Remove charging air cooler.

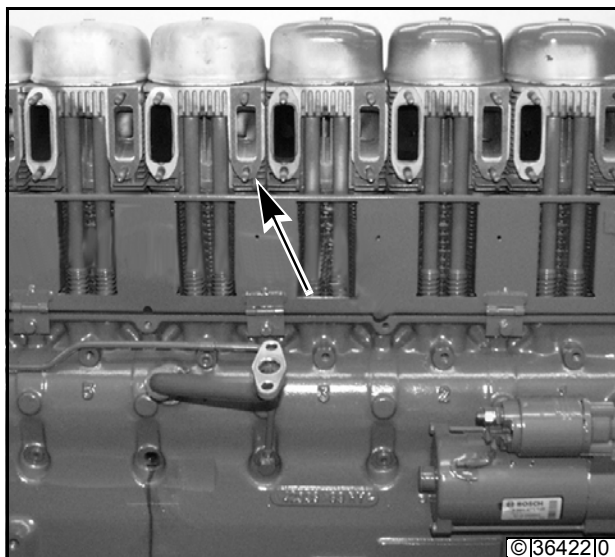


- Remove turbocharger and exhaust manifold  
- see work card **W 6-1-5**.



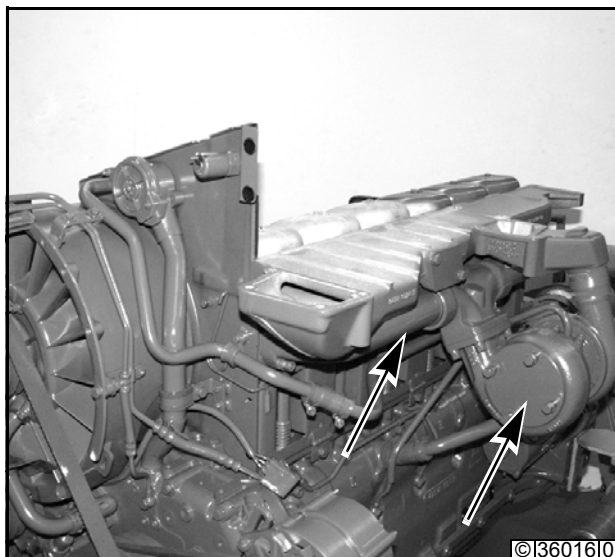


- Remove air suction pipe.



**Refit air suction pipe**

- Clean sealing surfaces.
- Fit air suction pipe with new gaskets. Tighten hex nuts.

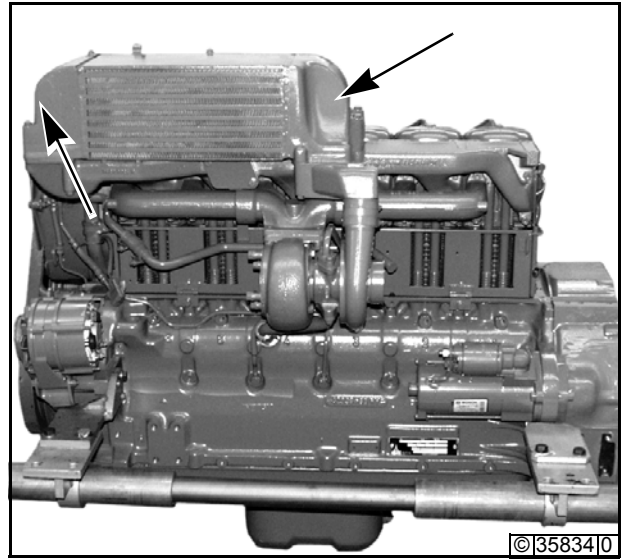


- Refit exhaust manifold and turbocharger  
- see work card **W 6-1-5**.

- Fit charging air cooler with new gaskets. Tighten bolts.



- Refit cooling air guide sheets  
- see work card W **W 9-11-3**.
- Refit line to charging air cooler.



**Exhaust System / Charging  
Work Card  
W 6-7-3**

**914**



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## Renewing the injection lines

**Tools**

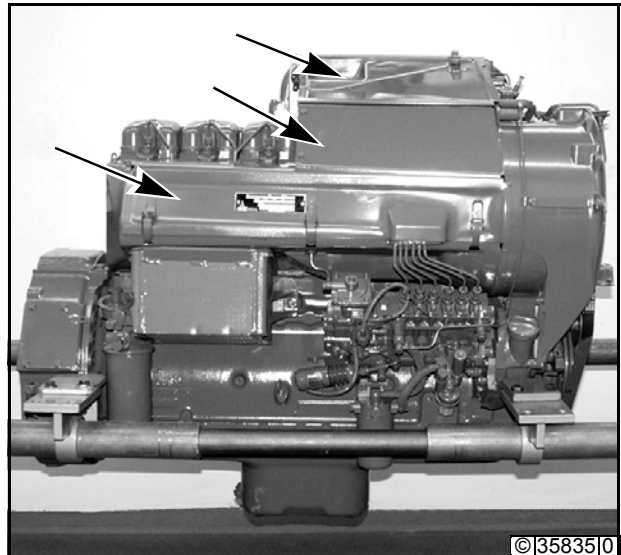
- Commercial tools

**Note**

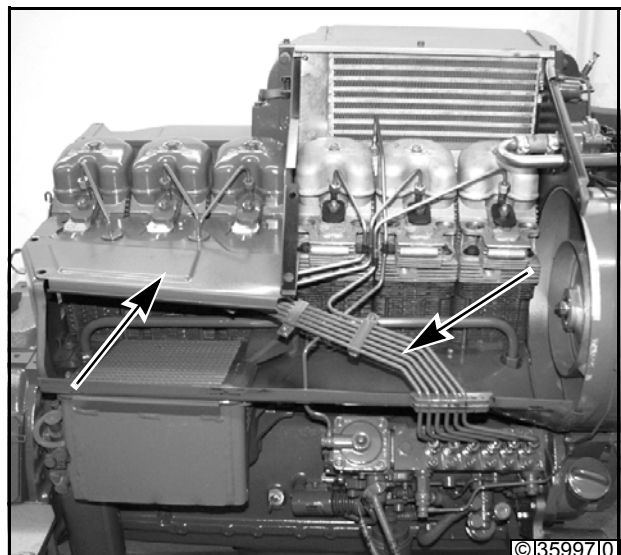
- Utmost cleanliness is required when working on the injection equipment.

### Remove injection lines

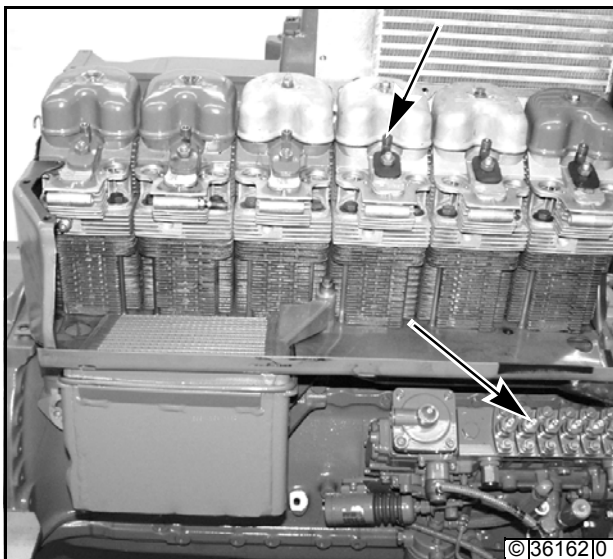
- Remove cooling air guide sheets.



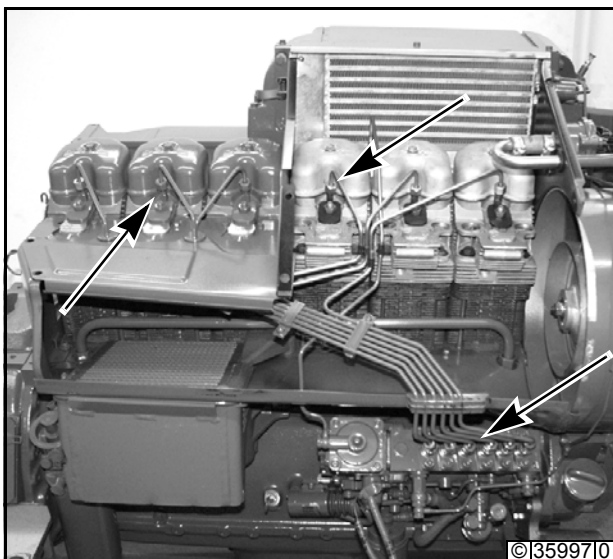
- Remove injection lines with cover plate.







- Refit cooling air guide sheets.



#### Renew injection lines

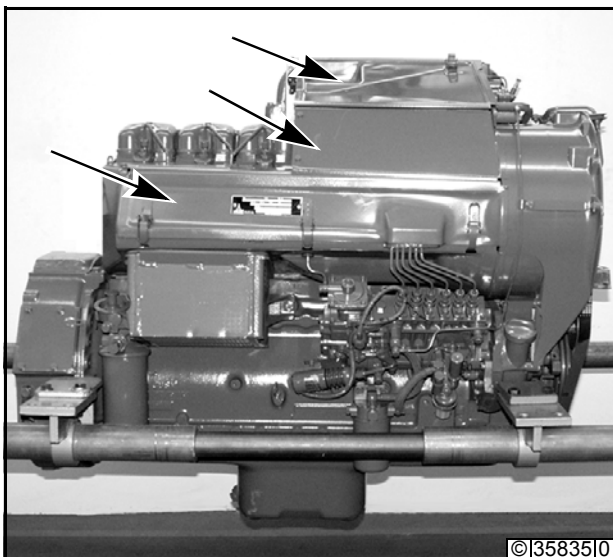
- Fit new injection lines with cover plate free of tension.



#### Note

Bending the injection lines can cause small cracks which reduce the long-term durability. Do not bend injection lines!

- Tighten cap nuts.



- Refit cooling air guide sheets.

## Removing and refitting the injection pump



### Tools

- Commercial tools
- Special tools
- Graduated disc \_\_\_\_\_ 100 910
- All-purpose device \_\_\_\_\_ 110 340
- Extra sleeve \_\_\_\_\_ 110 410



### References

- W 7-3-1
- W 7-6-1

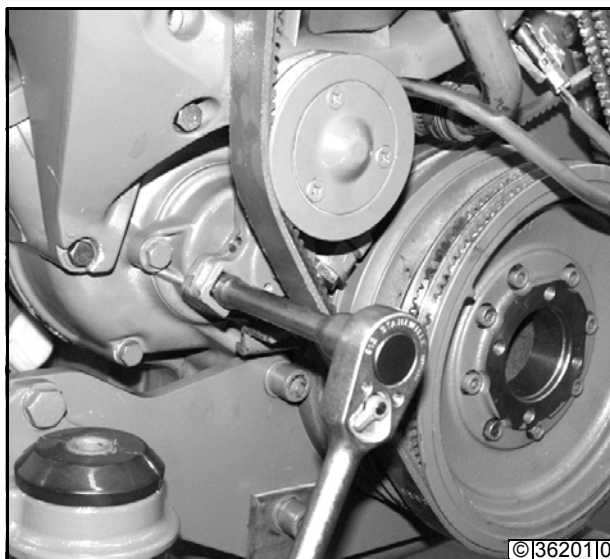


### Note

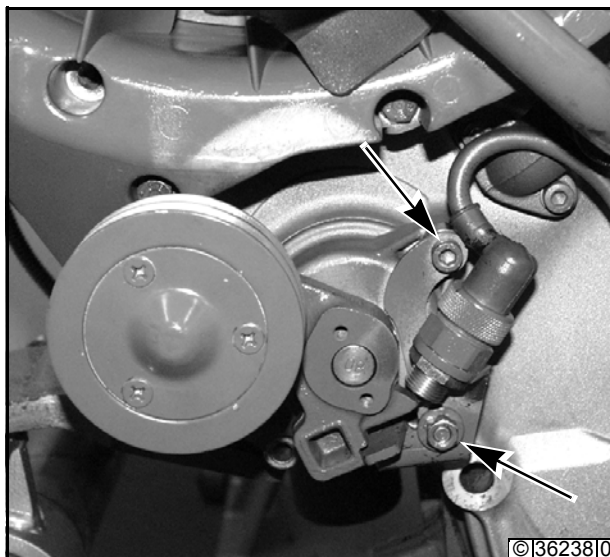
- Utmost cleanliness is required when working on the injection equipment.
- See repair instructions "Injection pump/governor" for checks and repairs on the injection pump

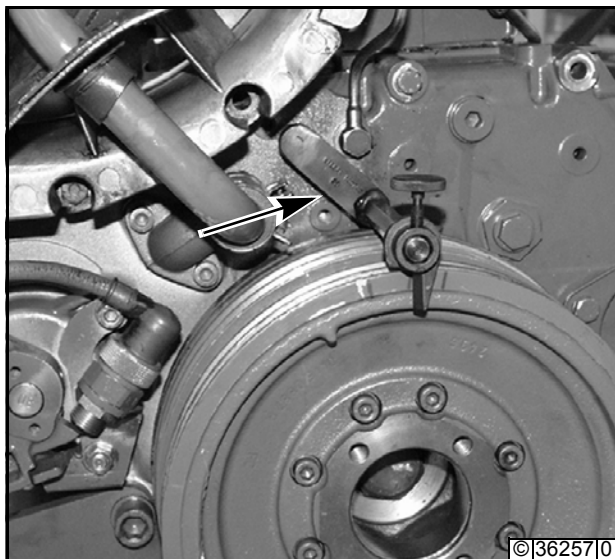
### Remove injection pump

- Tension V-belt idler pulley with a suitable tool and remove V-belt.



- Remove V-belt idler pulley.

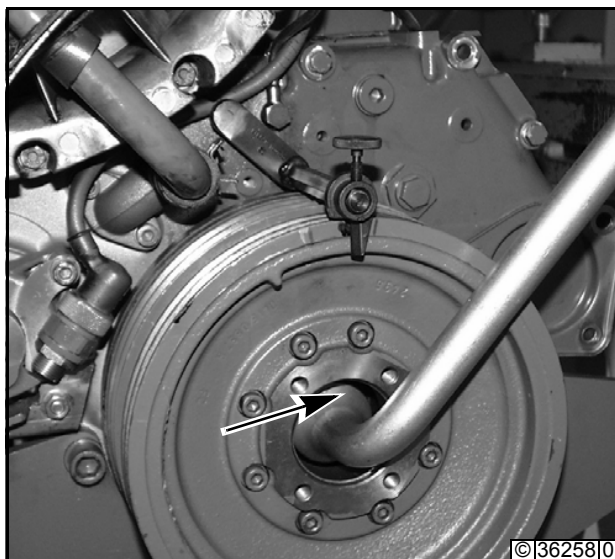




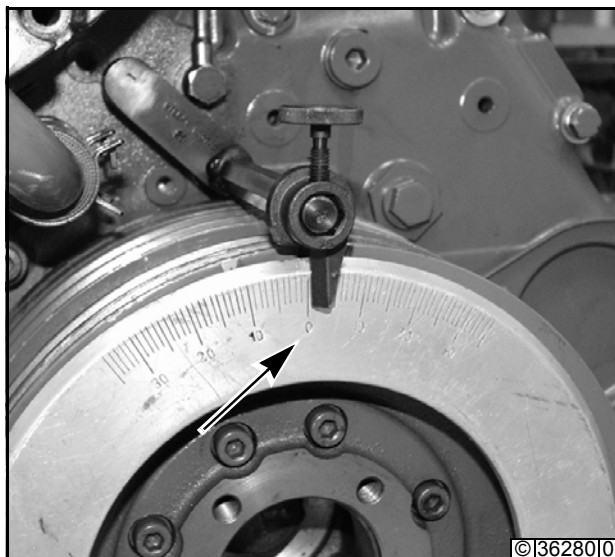
**Note**

Top Dead Center (TDC) marking has been determined. Check TDC if necessary  
- see work card **W 1-2-5**.

- Fit pointer.



- Turn crankshaft in direction of engine rotation until TDC marking on V-belt pulley in firing TDC of cylinder no.1 coincides with pointer.



- Position graduated disc to coincide with TDC marking.  
The markings must agree.
- Turn crankshaft by about 90° in opposite direction of engine rotation.

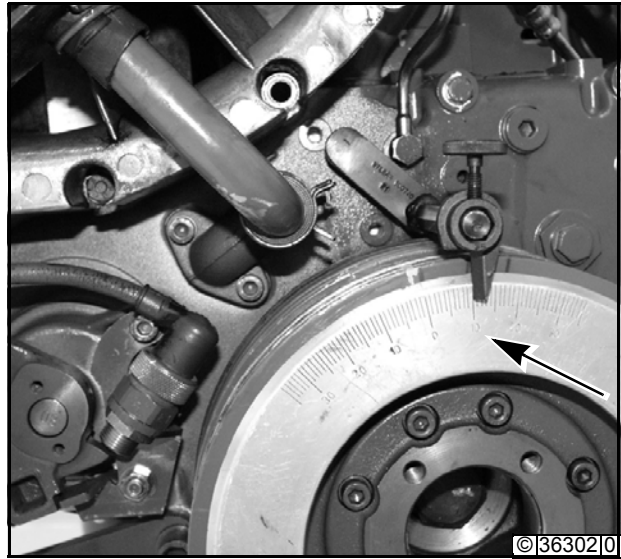


- Turn crankshaft in direction of engine rotation until the corresponding commencement of delivery has been reached on the graduated disc.

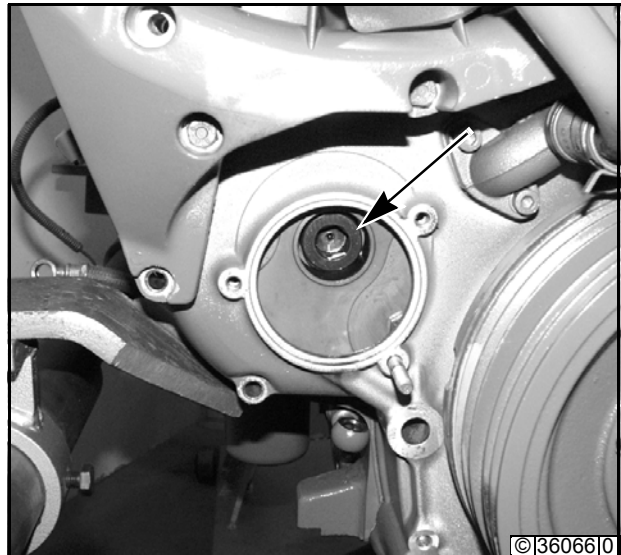


## Note

Observe data on the engine nameplate.  
Secure crankshaft against rotation.



- Remove tensioning nuts from injection pump gear/injection timing mechanism.



## Note

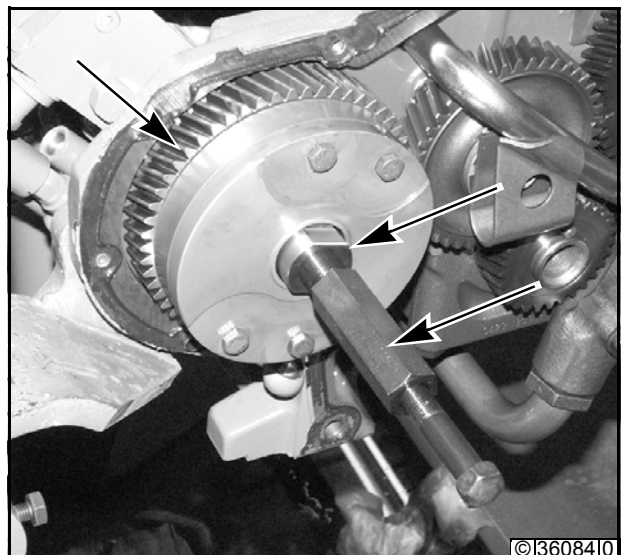
The front cover has been removed here to provide a clearer overview.

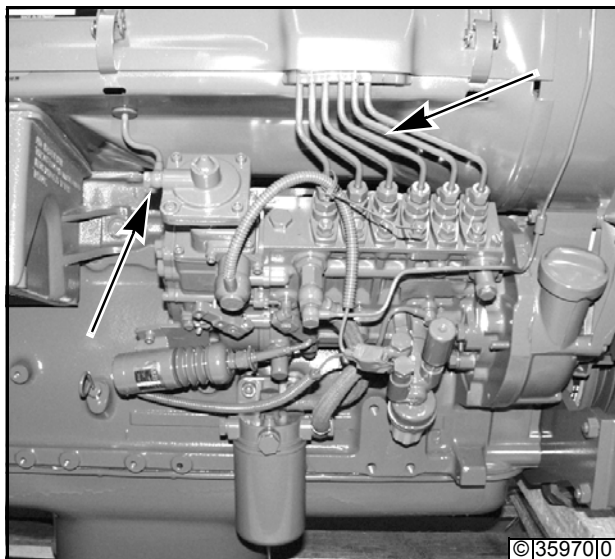
- Undo injection pump gear/injection timing mechanism using extracting device and extra sleeve.



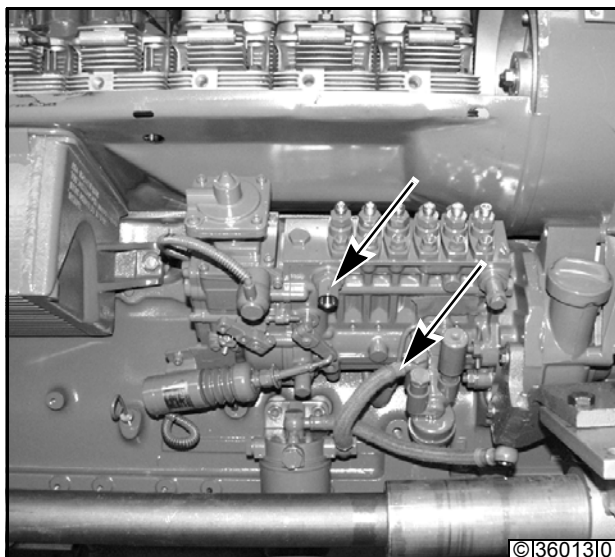
## Note

Ensure Woodruff key is fitted.

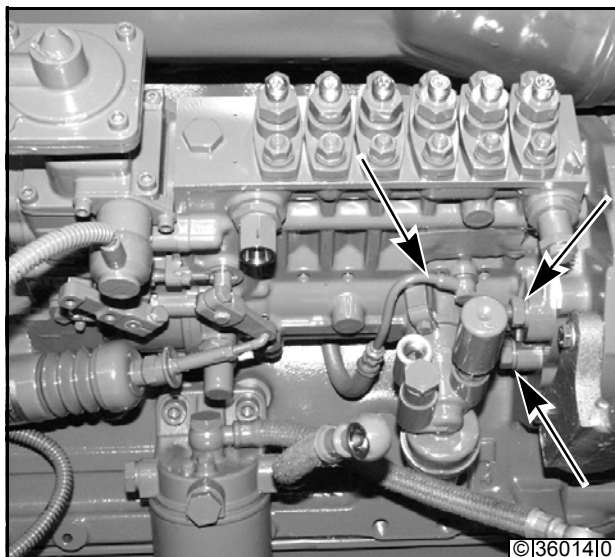




- Remove injection lines  
- see work card **W 7-3-1**.
- Remove line LDA.



- Remove fuel lines.



- Remove lube oil line.
- Remove hex nuts (four) from injection pump and  
take out injection pump.

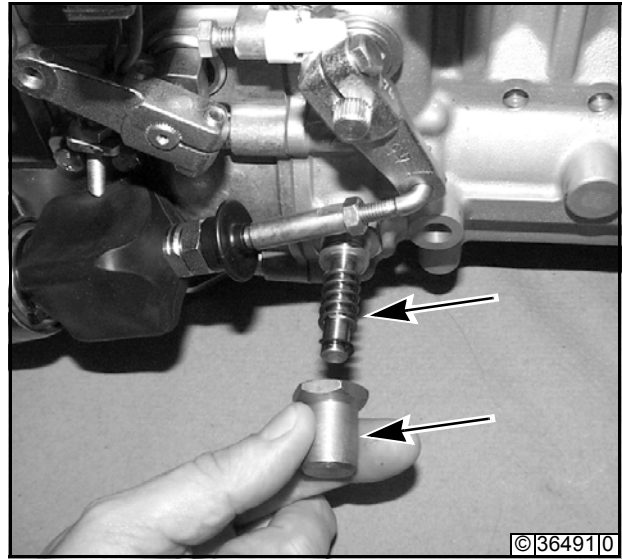


**Caution**

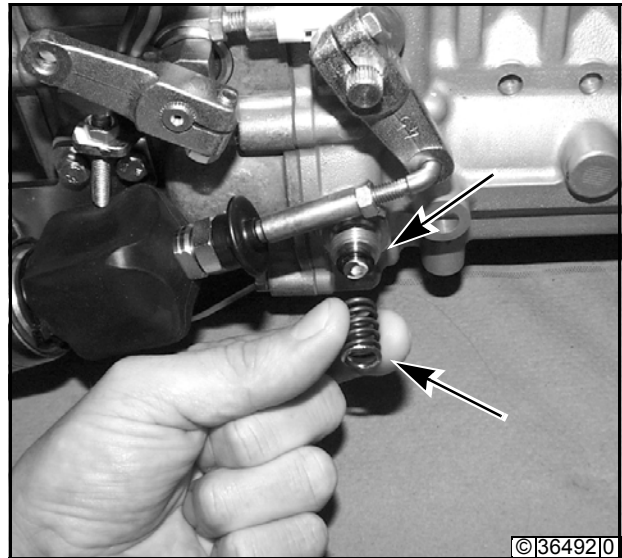
Do not turn the crankshaft after removing  
the injection pump.

**Refit injection pump**

- Remove positioning bolt sleeve. Take out positioning bolt with compression spring.



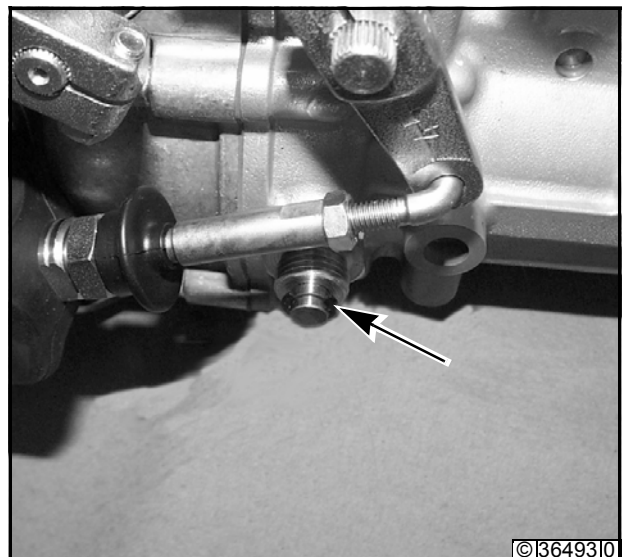
- First insert positioning bolt then compression spring into injection pump.



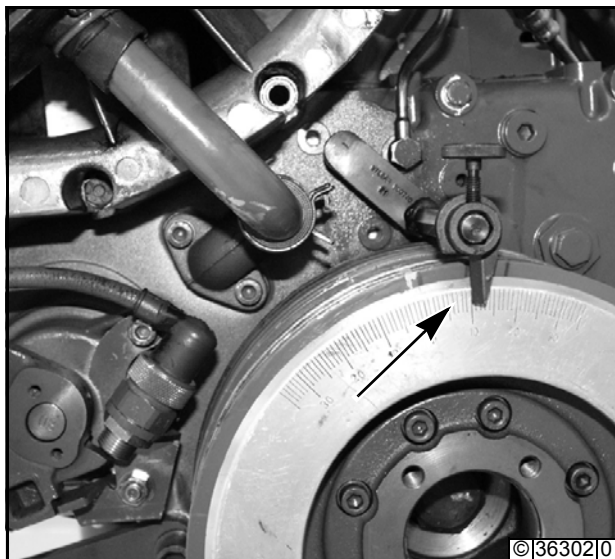
- Turn injection pump camshaft by hand until positioning bolt latches into place.
- Fasten compression spring and positioning bolt sleeve.

**Note**

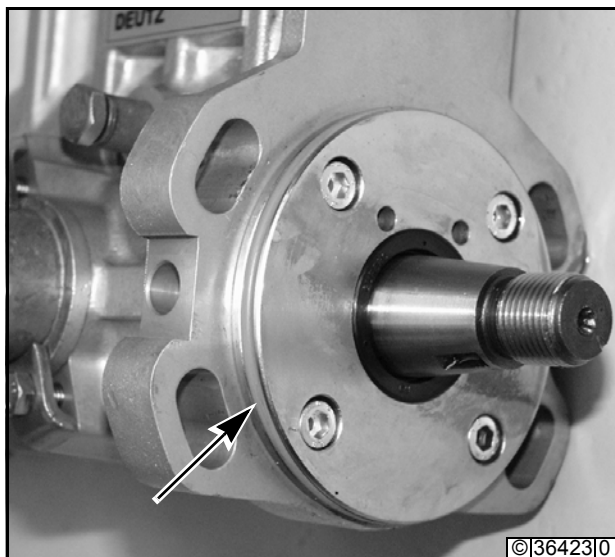
This corresponds to commencement of delivery of 1st cylinder.



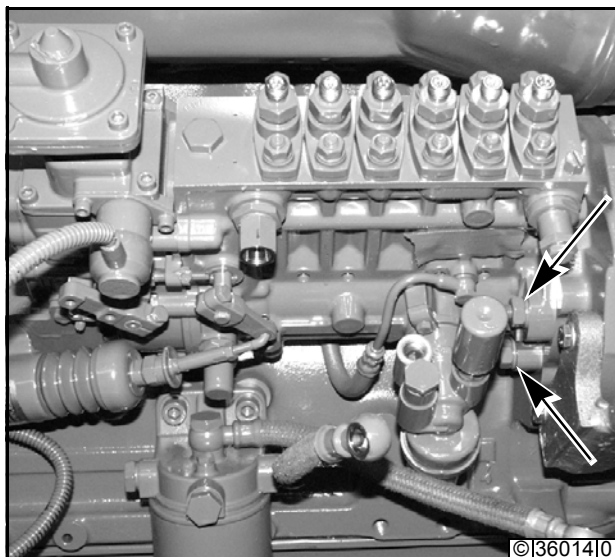




- Check PB markings on cylinder no.1.



- Insert injection pump with new O-ring seal.



- Insert injection pump oriented to injection pump gear/injection timing mechanism.



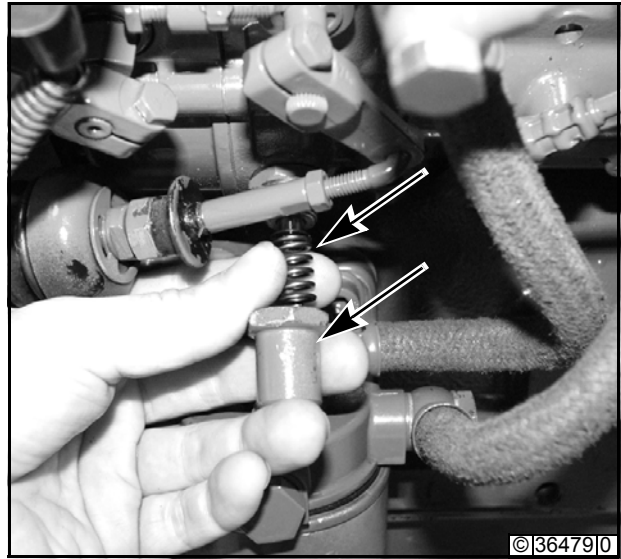
**Hinweis**

Ensure Woodruff key is fitted.

- Loosely tighten hex nuts (four).



- Remove positioning bolt sleeve, compression spring and positioning bolt.



- Slide compression spring over positioning bolt and insert into injection pump.
- Fasten positioning bolt sleeve.



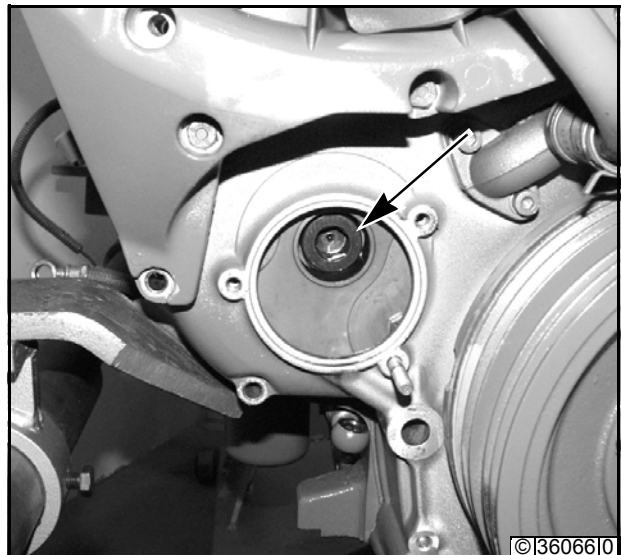
913

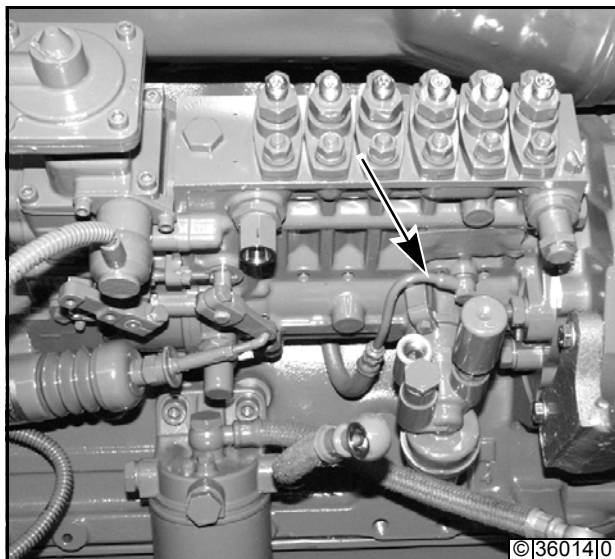


- Tighten tensioning nuts of injection pump gear/injection timing mechanism.

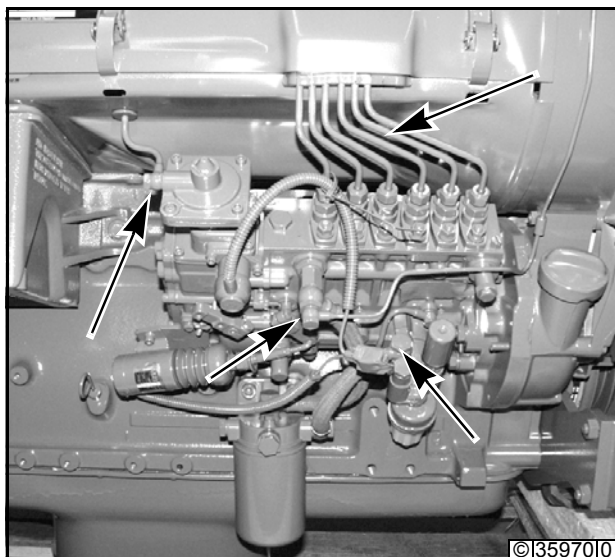


983





- Refit lube oil line.



- Renew injection lines  
- see work card **W 7-3-1**.
- Refit fuel lines.



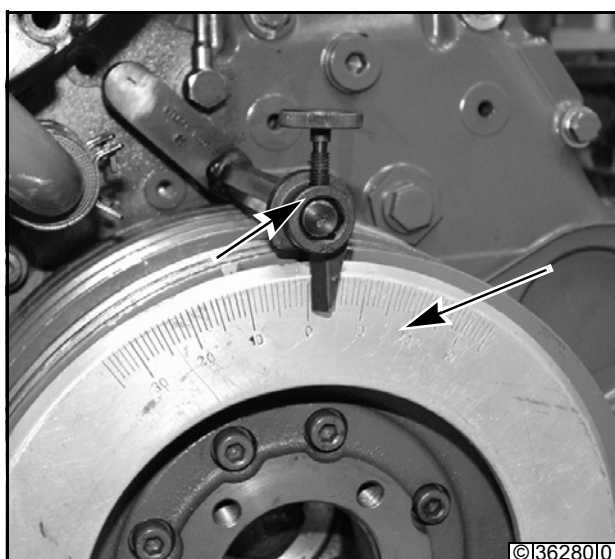
**Note**

Mount injection lines free of tension; Undo injection pump if necessary.

- Fasten injection pump.

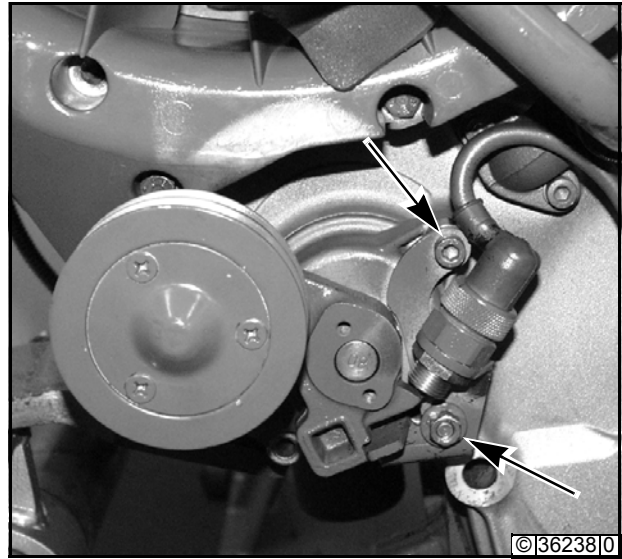


- Refit line LDA.
- Remove anti-torsion fittings.
- Recheck commencement of delivery  
- see work card **W 7-6-1**.



- Remove pointer and graduated disc.

- Refit V-belt idler pulley.





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## Checking and setting the commencement of delivery, with positioning bolt



### Tools

- Special tools
- Pointer \_\_\_\_\_ 100 740
- Graduated disc \_\_\_\_\_ 100 910
- H.P. hand feed pump \_\_\_\_\_ 101 500
- Reservoir tank \_\_\_\_\_ 101 510



### Note

- The V-belt has been disassembled in this work process to provide a clearer overview.

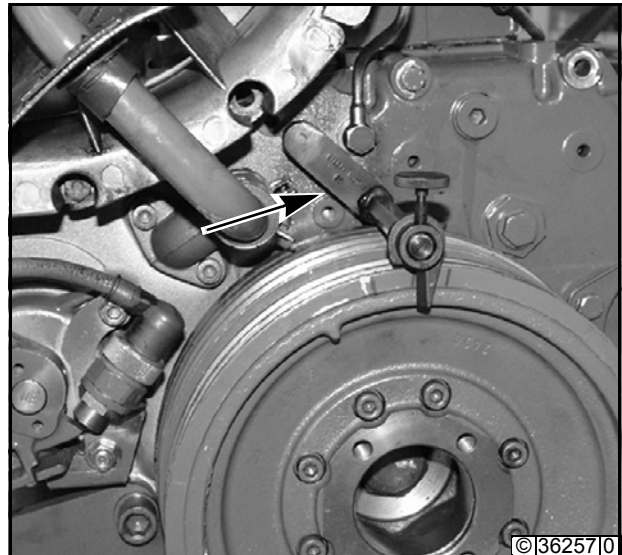
### Check commencement of delivery



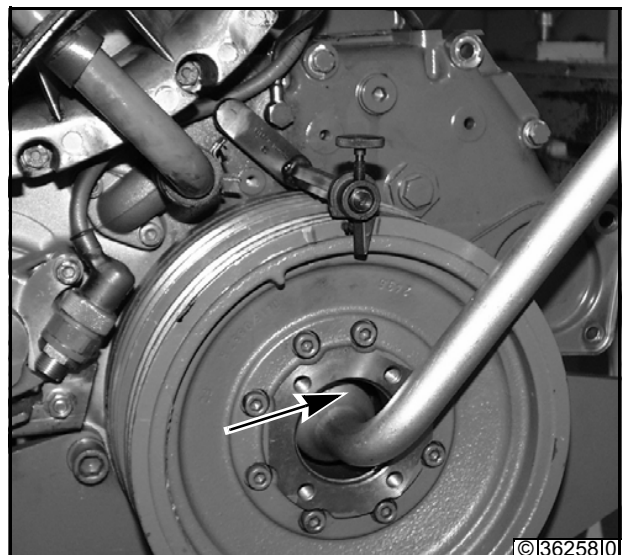
### Note

- Top Dead Center (TDC) marking has been determined. Check TDC if necessary
- see work card **W 1-2-5**.

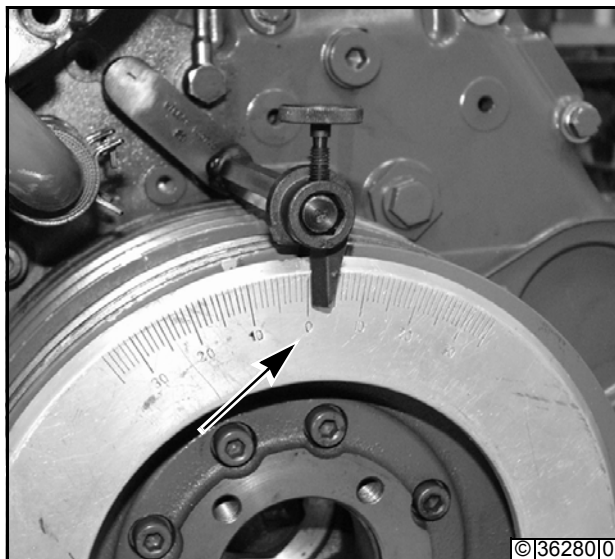
- Fit pointer.



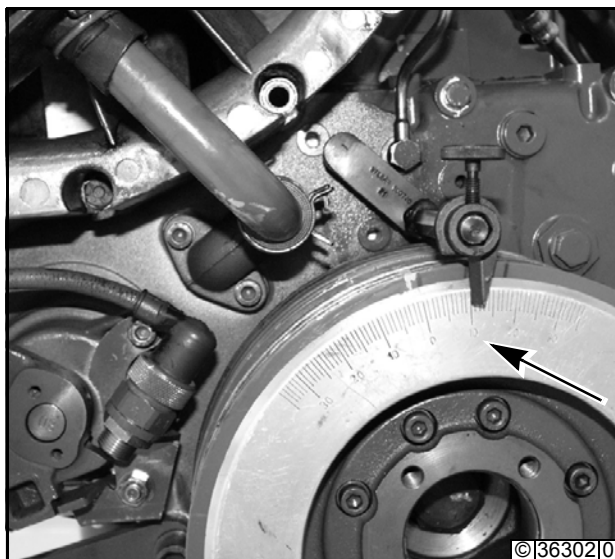
- Turn crankshaft in direction of engine rotation until TDC marking on V-belt pulley in firing TDC of cylinder no.1 coincides with pointer.







- Position graduated disc to coincide with TDC marking.  
The markings must agree.
- Turn crankshaft by about 90° in opposite direction of engine rotation.

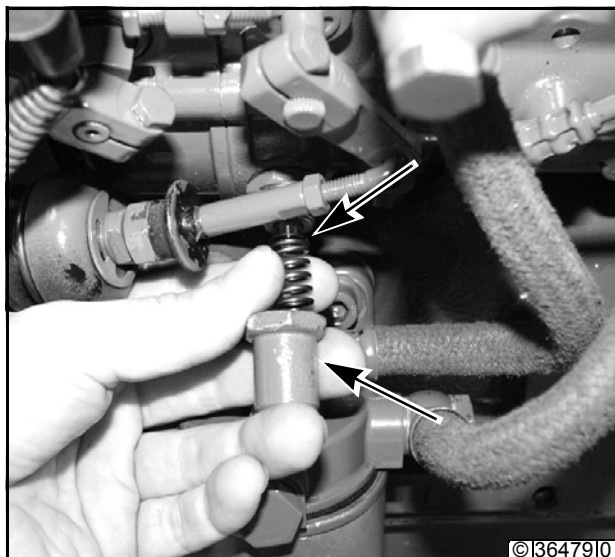


- Turn crankshaft in direction of engine rotation until the corresponding commencement of delivery has been reached on the graduated disc.



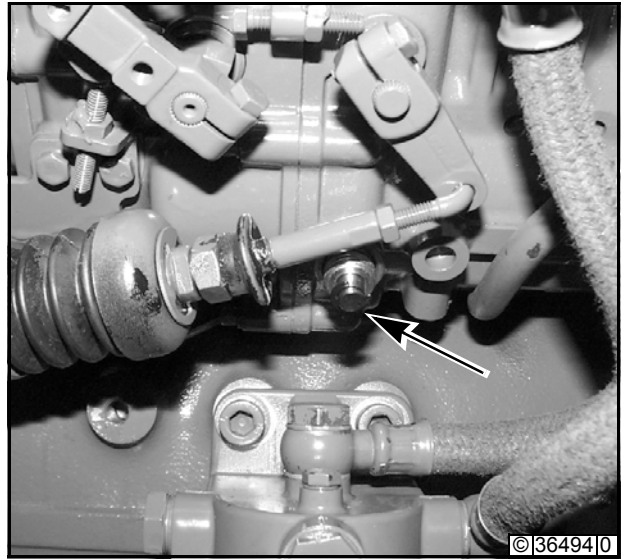
**Note**

Observe data on the engine nameplate.



- Remove positioning bolt sleeve. Take out positioning bolt and compression spring.

- Insert positioning bolt without compression spring into injection pump.



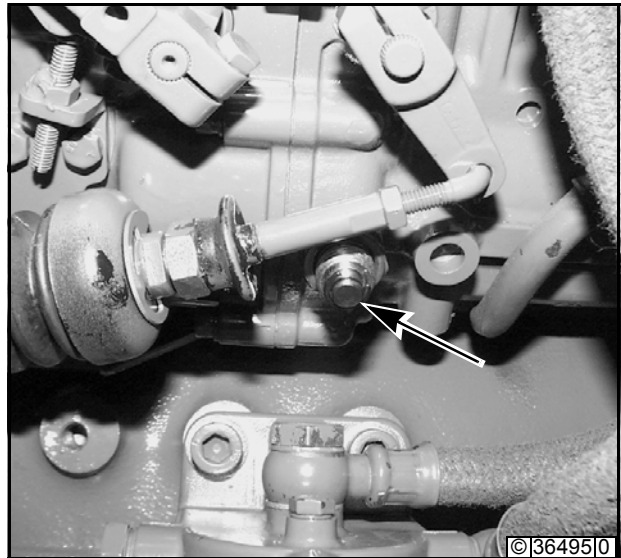
- Positioning bolt must latch into recess in the injection pump camshaft.



## Note

This corresponds to commencement of delivery of 1st cylinder.

- If the positioning bolt does not latch into injection pump camshaft, set commencement of delivery as follows.

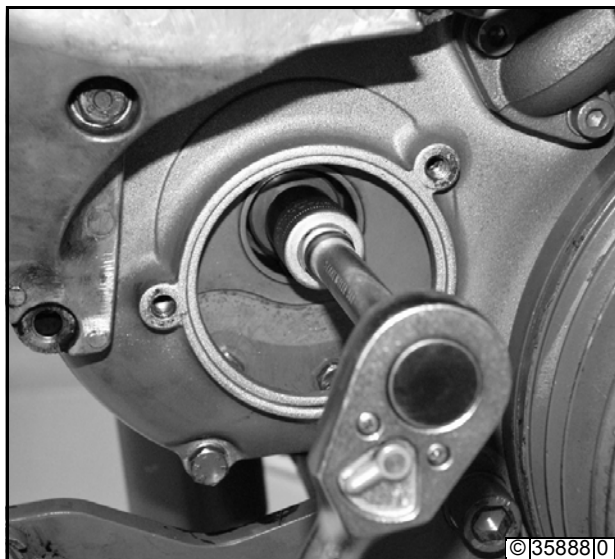


## Set commencement of delivery

- Undo bolts (four) on injection pump gear/injection timing device.







- Twist camshaft of injection pump until positioning bolt latches into recess. Remove positioning bolt.



- Tighten bolts (four) of injection pump gear/injection timing device.

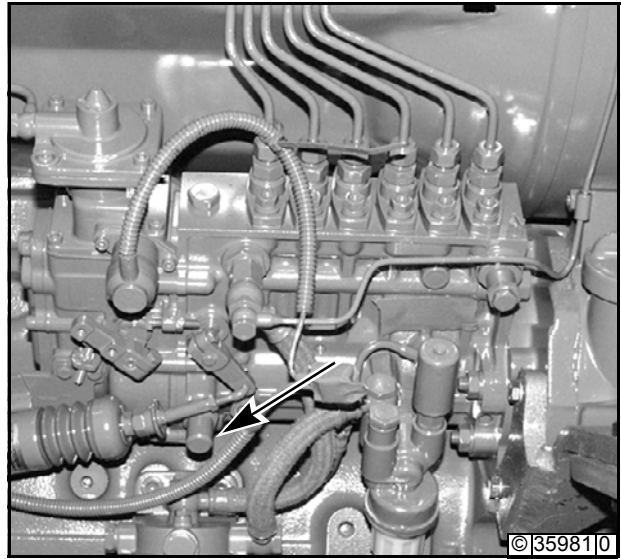


- Recheck commencement of delivery.

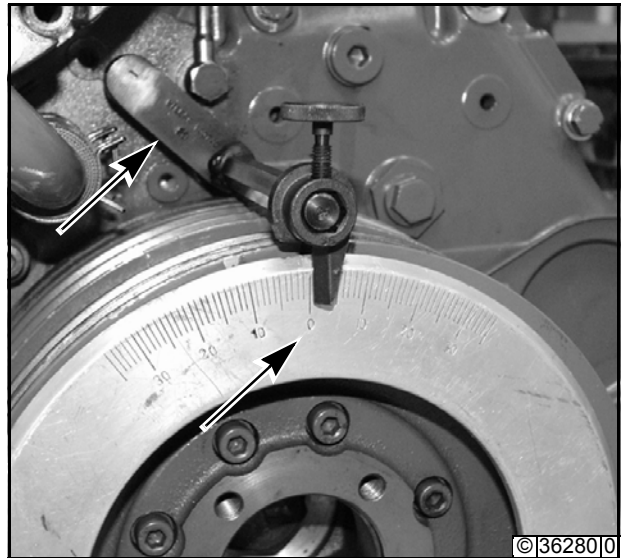


- Slide compression spring over positioning bolt and insert into injection pump.

- Fasten positioning bolt sleeve.



- Remove pointer and graduated disc.



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## Checking and setting the commencement of delivery, with high-pressure pump



### Tools

- Special tools
- Pointer \_\_\_\_\_ 100 740
- Graduated disc \_\_\_\_\_ 100 910
- H.P. hand feed pump \_\_\_\_\_ 101 500
- Reservoir tank \_\_\_\_\_ 101 510

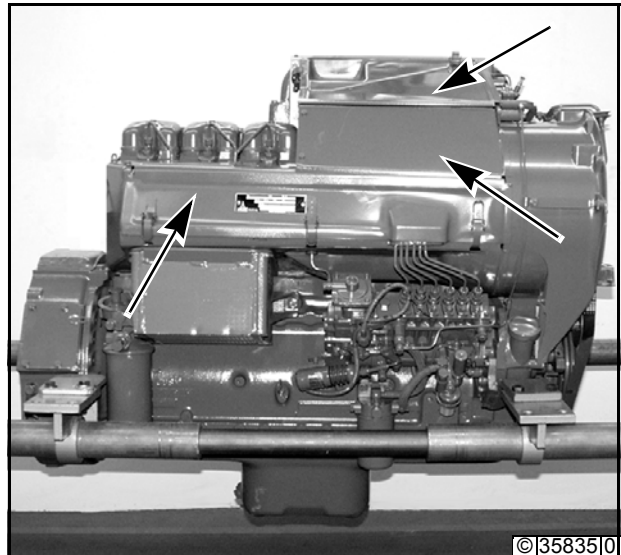


### Note

- The V-belt has been disassembled in this work process to provide a clearer overview.

### Check commencement of delivery

- Remove cooling air guide sheets.

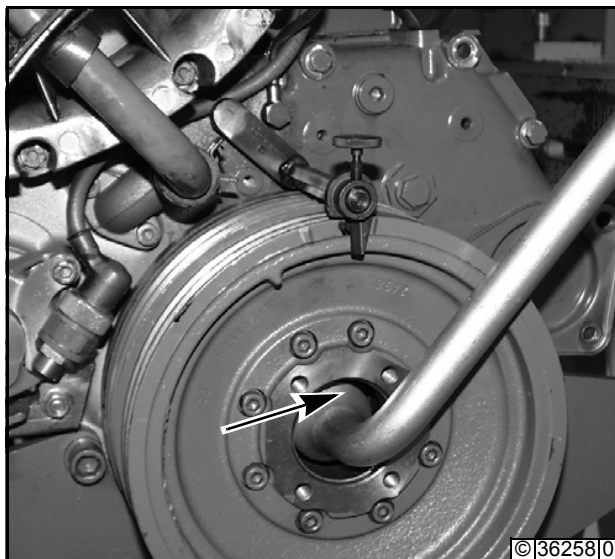


### Note

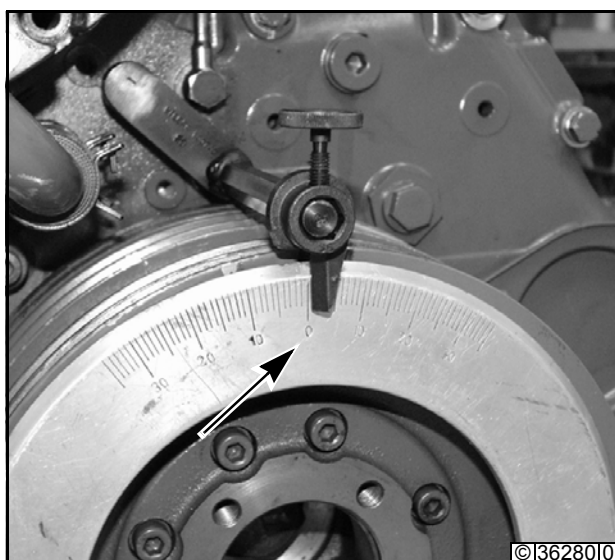
- Top Dead Center (TDC) marking has been determined. Check TDC if necessary
- see work card **W 1-2-5**.

- Fit pointer.

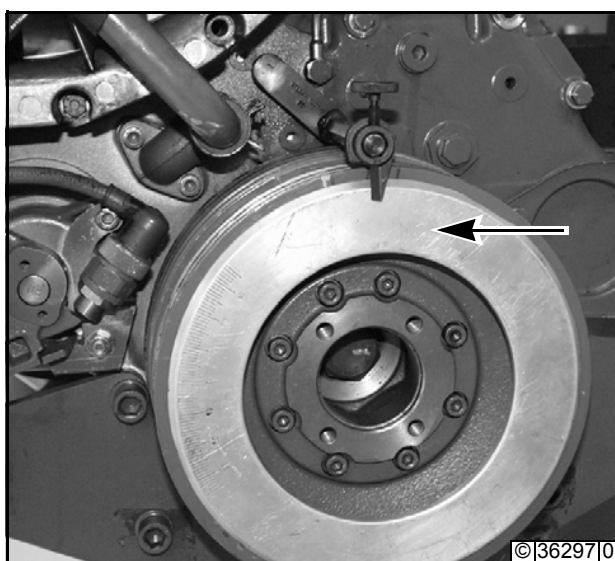




- Turn crankshaft in direction of engine rotation until TDC marking on V-belt pulley in firing TDC of cylinder no.1 coincides with pointer.



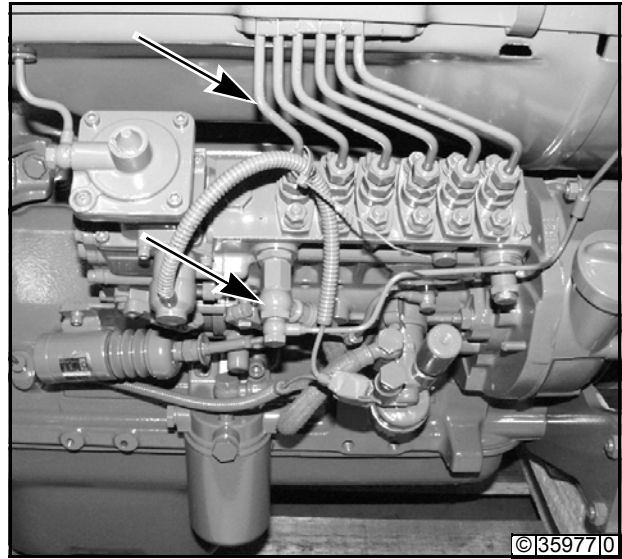
- Position graduated disc to coincide with TDC marking.  
The markings must agree.



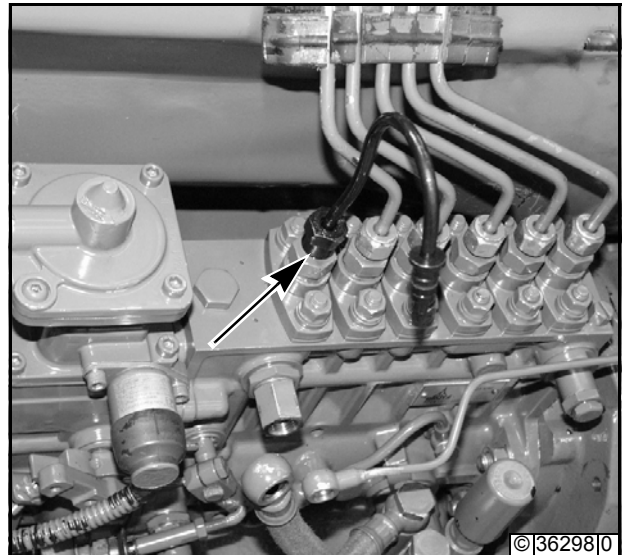
- Turn crankshaft by about 90° in opposite direction of engine rotation.



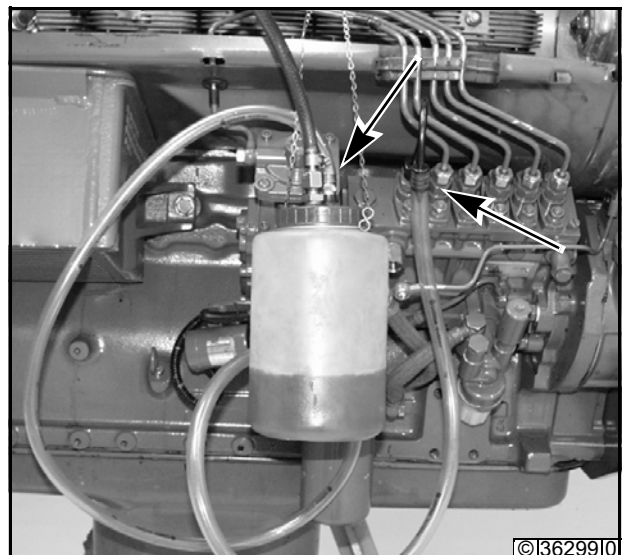
- Remove injection line for cylinder no.1 and fuel lines.

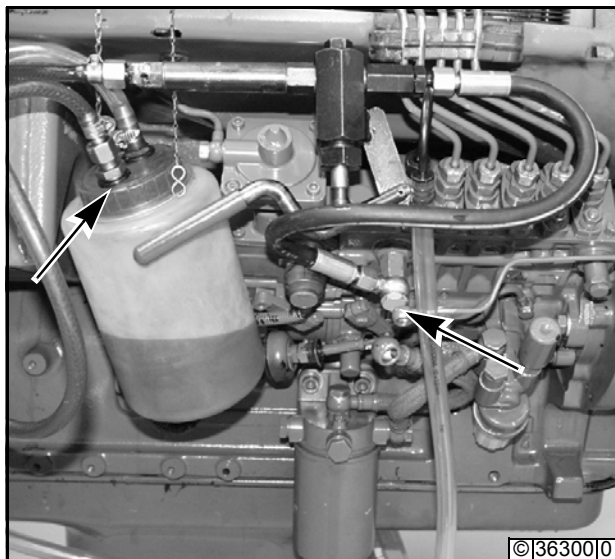


- Fit pipe elbow.

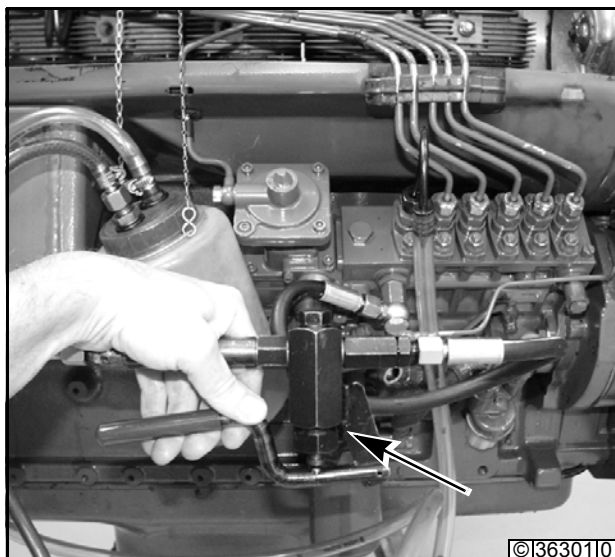


- Connect return hose to pipe elbow and on reservoir tank.





- Connect delivery line of H.P. hand feed pump to injection pump and suction line on reservoir tank.
- Fill reservoir tank with clean fuel.

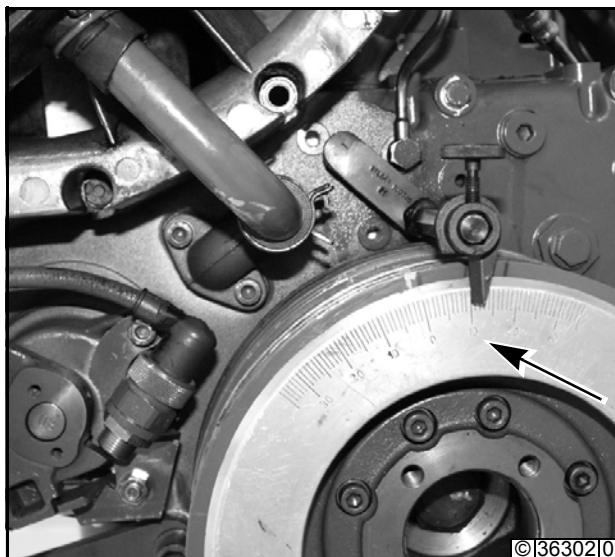


- Bleed the air from suction chamber of injection using H.P. hand feed pump. Continue to operate H.P. hand feed pump and turn crankshaft slowly in direction of engine rotation until the flow of fuel slows to a drip.



**Note**

Apply current to stop magnet and remove start magnet.



- Read off commencement of delivery from graduated disc.



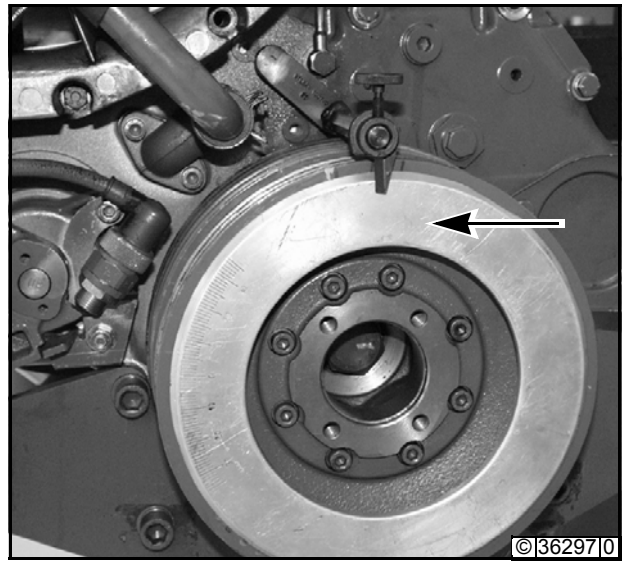
**Note**

If commencement of delivery does not agree with the data on the engine nameplate, reset commencement of delivery as follows.

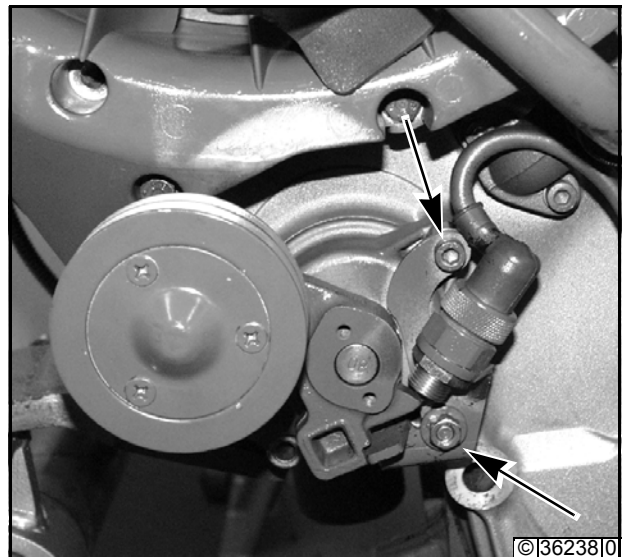


**Set commencement of delivery**

- Turn crankshaft by about 90° in opposite direction of engine rotation. Then turn crankshaft in direction of engine rotation until the value specified for commencement of delivery coincides with the pointer. Check markings.

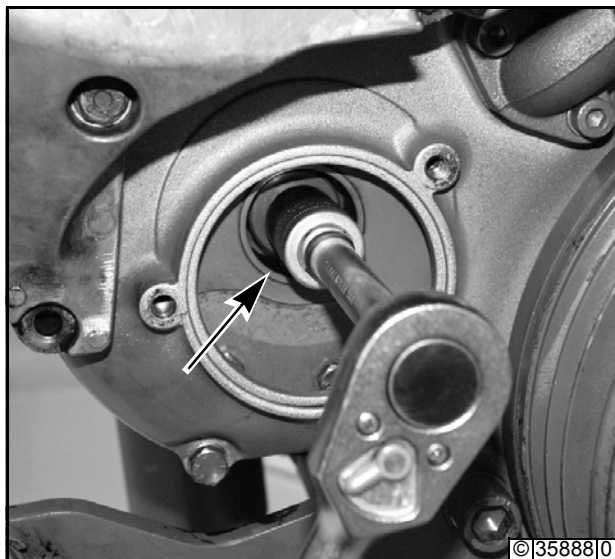


- Remove V-belt idler pulley.



- Undo bolts of injection pump gear/injection timing mechanism.





- Operate H.P. hand feed pump and turn camshaft of injection pump in direction of engine rotation until the flow of fuel slows to a drip.

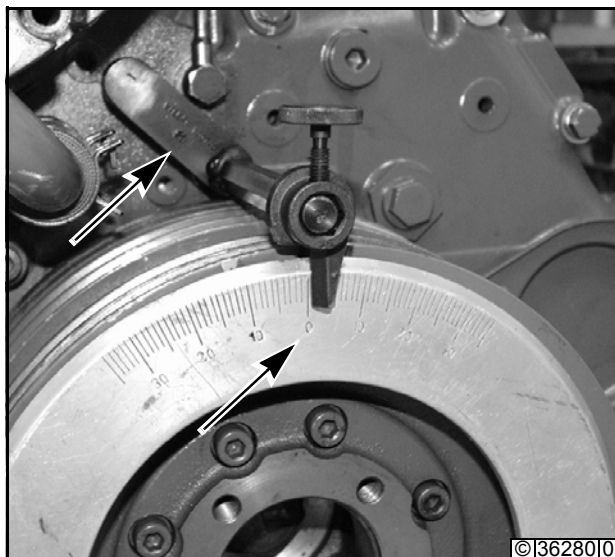


- Tighten bolts of injection pump gear/injection timing mechanism with the appropriate torque.



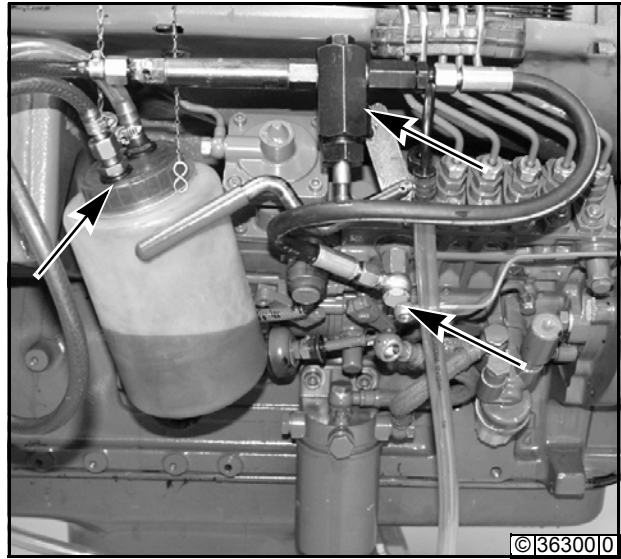
**Note**

Recheck commencement of delivery, if necessary repeat the setting work.



- Remove pointer and graduated disc.

- Remove high-pressure pump, reservoir tank and pipe elbow.



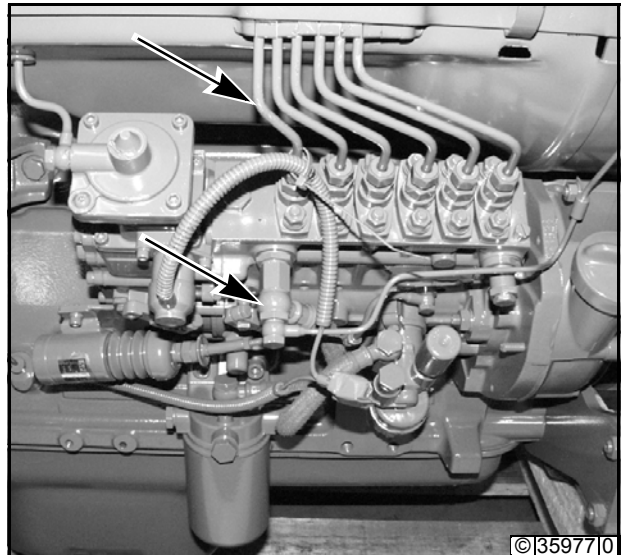
## Note

Reinstall stop magnet and start magnet.

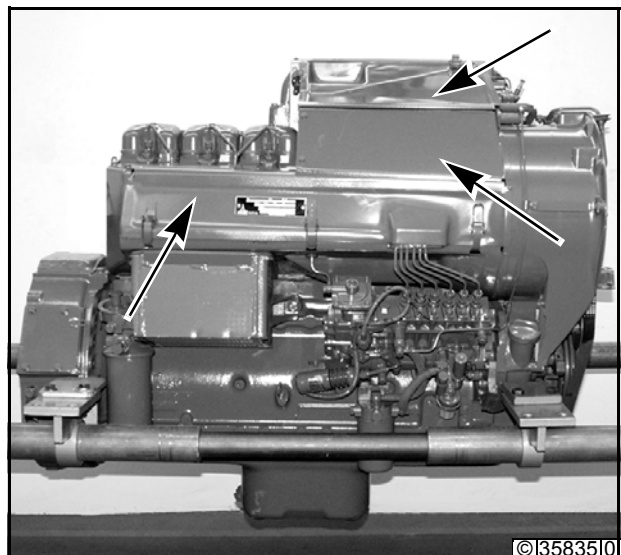
- Fit new injection line and tighten cap nuts.



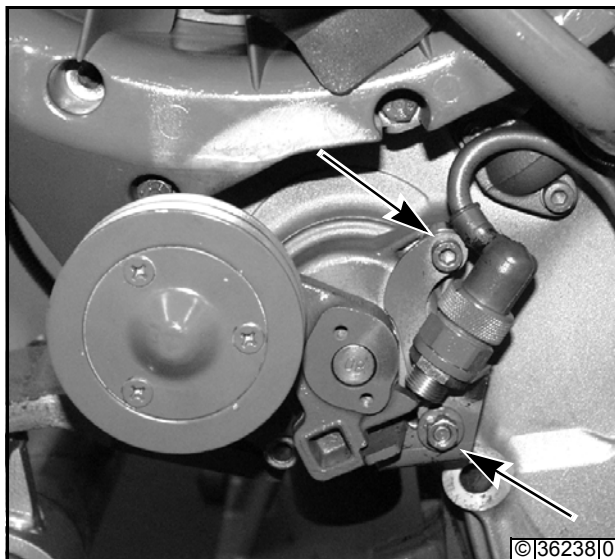
- Tighten fuel lines with new Cu sealing rings.



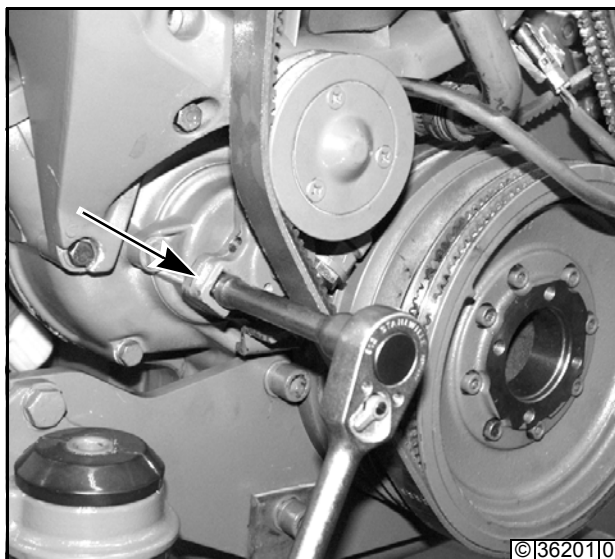
- Refit cooling air guide sheets.







- Fit idler pulley with new O-ring seal. Tighten bolts with the appropriate torque.



- Tension idler pulley with a suitable tool and place on V-belt.

## Removing and refitting the injectors



### Tools

- Commercial tools
- Special tools

Extractor	_____	110 030
Extracting device	_____	120 630
Extracting device	_____	150 800

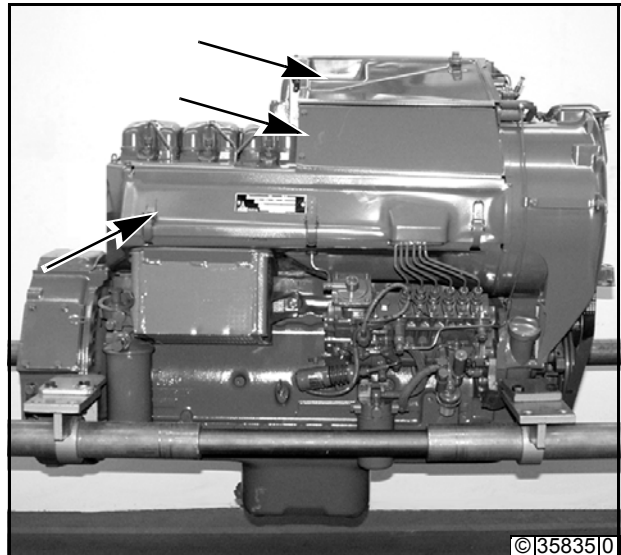


### Note

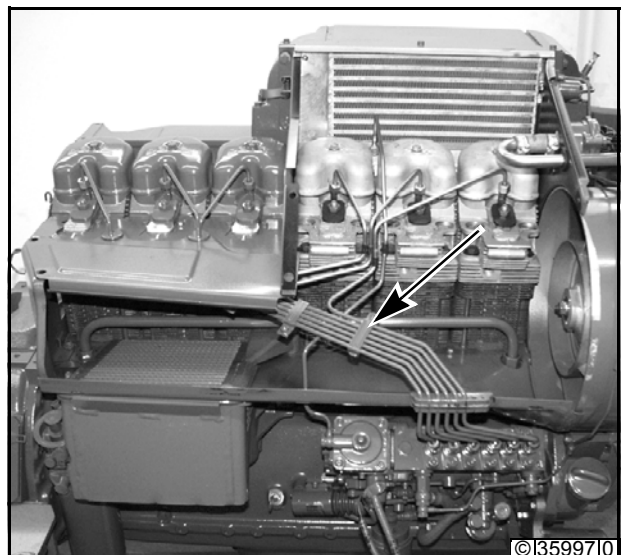
- Utmost cleanliness is required when working on the injection equipment.

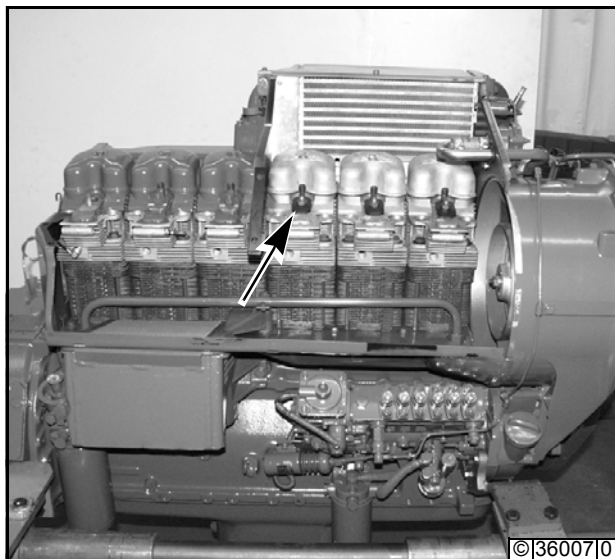
### Dismount injectors

- Remove cooling air guide sheets.



- Remove injection lines.

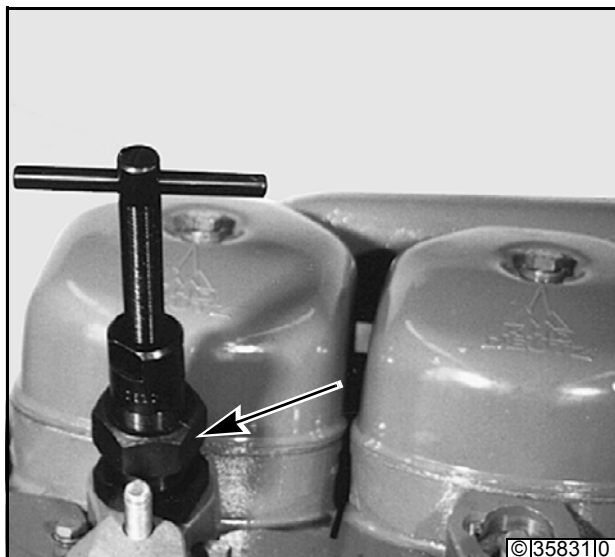




- Dismount injectors.



- If injector is jammed, use extracting device **150 800** with extractor.



- If sealing ring is jammed, use extracting devices **120 630**.

**Refit injectors**

- Adhere new sealing ring with a little grease.
- Insert injectors.



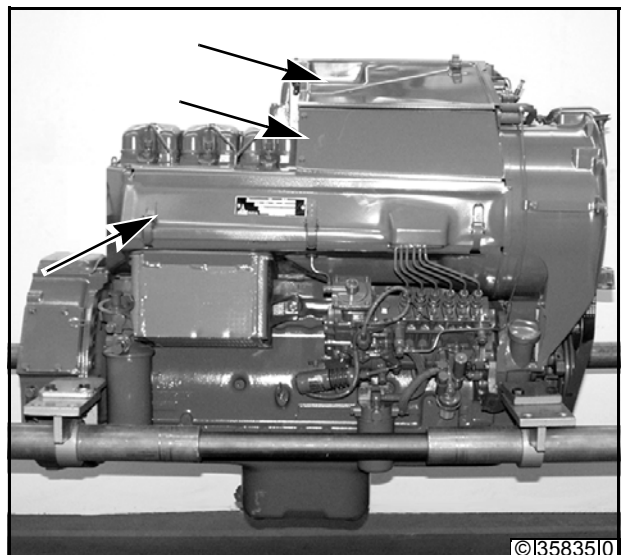
- Place on clamping pad. Tighten hex nut.



- Renew injection lines.



- Refit cooling air guide sheets.





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## Checking and adjusting the injectors



### Tools

- Commercial tools
  - Long socket, 15 across flats \_\_\_\_\_ 8012
  - Nozzle tester \_\_\_\_\_ 8005
- Special tools
  - Assembly device \_\_\_\_\_ 110 110



### Note

- Utmost cleanliness is required when working on the injection equipment. Only use pure testing oil to ISO 4113 or clean diesel fuel for testing the injectors.



### Caution

- After actuating the hand lever 3 or 4 times, the spring chamber above nozzle needle in the injector fills with leak fuel/test oil. It is then not possible to actuate the hand lever. Undo the nozzle tensioning nut carefully before performing each test in order to release the pressure from the spring chamber.

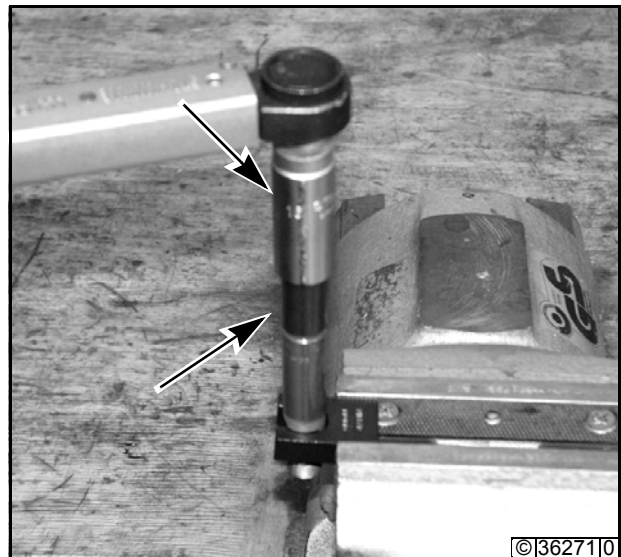


### References

- W 7-7-1

### Adjust injector

- Remove injectors
  - see work card **W 7-7-1**.
- Insert injector into assembly device and undo the nozzle tensioning nut approx. 180° (release pressure) and then retighten.



### Caution

Keep hands away from the fuel jet. The fuel penetrates deeply into the skin and may cause blood poisoning.

- Connect injector to nozzle tester.





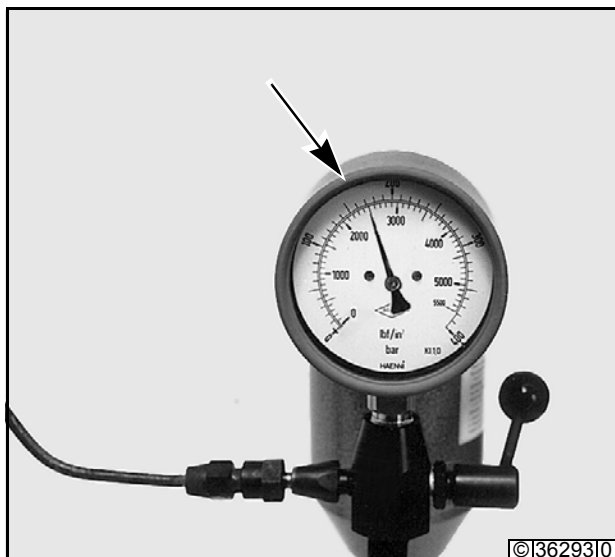
### Checking opening pressure

- With pressure gauge switched on, slowly press down lever of nozzle tester. The pressure at which the gauge pointer stops, or suddenly drops, is the opening pressure.



### Note

After actuating the hand lever on the nozzle tester 3 or 4 times, the pressure builds up again in the spring chamber. Undo the tensioning nut again and retighten before repeating the test.



- If the values measured in 3 tests are the same, these can then be regarded as valid.

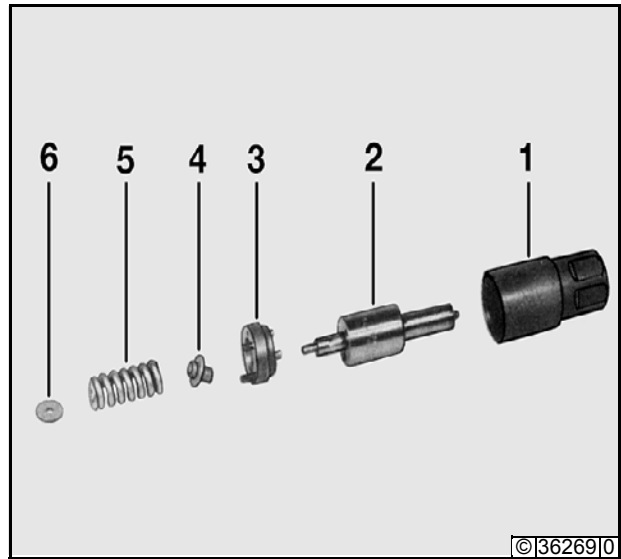


### Adjust injector

- Remove injector from nozzle tester.
- Insert injector into assembly device and screw off nozzle tensioning nut, disassemble all parts.

### Sequence of part assembly

- 1 Nozzle tensing nut
- 2 Injection nozzle
- 3 Adapter
- 4 Thrust pin
- 5 Compression spring
- 6 Shim



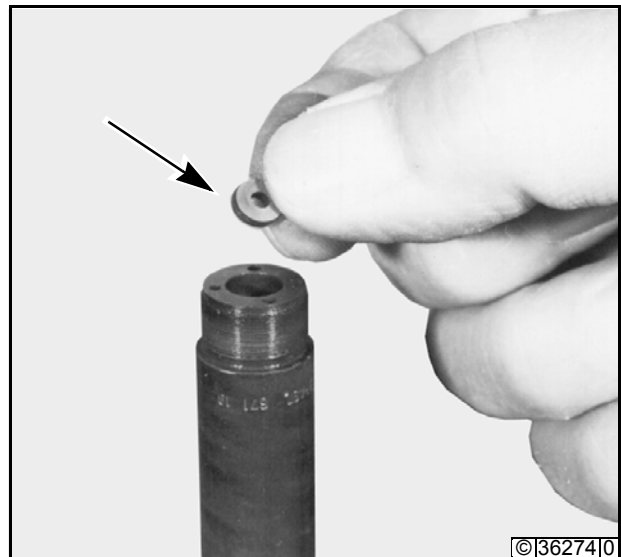
### Note

A thicker shim increases the opening pressure.

- Reassemble injector. Tighten nozzle tensing nut with the appropriate torque.



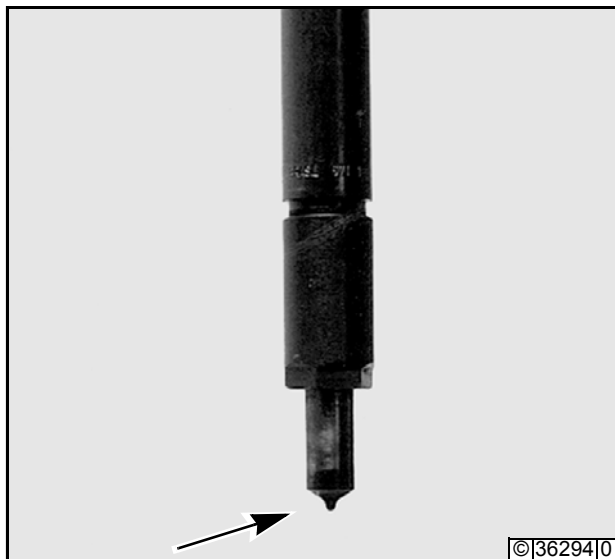
- Recheck injector on nozzle tester.



### Check for tightness

- Dry nozzle and nozzle holder - blow dry with air.
- Press down hand lever of tester slowly up to about 20 bar below the opening pressure previously read off is attained.





**Note**

Injection nozzle is tight if there is no dripping within a 10 second period.

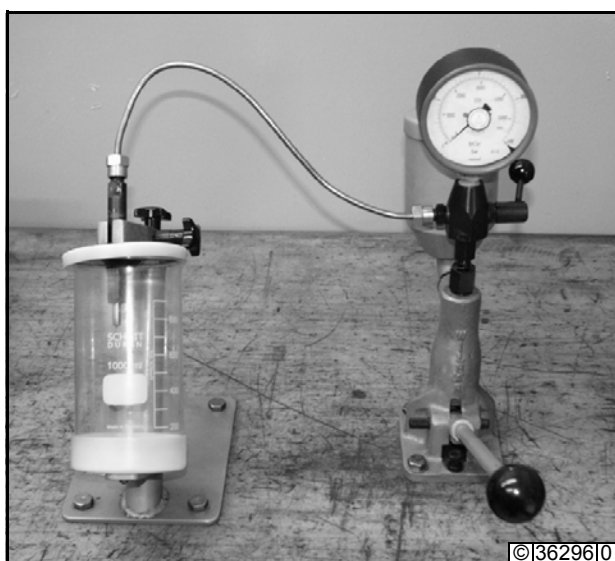


- If a drip does fall, dismantle the injector and clean it to remedy the leak. If this does not work, the injection nozzle must be renewed.



**Note**

Reworking is not permissible.



**Buzzing and spray pattern test**

- Switch off pressure gauge on tester.



**Note**

The buzzing test permits an audible check to be made whether the nozzle needle moves easily in the nozzle body. New injectors emit a different buzzing sound compared to used injectors. It deteriorates due to wear around the needle seat. If an injection nozzle does not buzz despite cleaning, it must then be replaced. A clear buzz should be heard from a used injector when the hand lever is actuated rapidly, while exhibiting a well atomised spray pattern. The spray pattern may differ noticeably from that of a new injector.

## Removing and refitting the fuel lines



### Tools

- Commercial tools

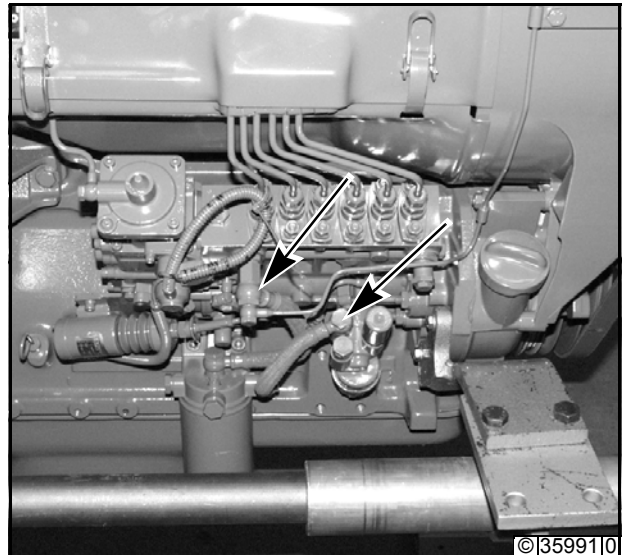
### Remove fuel lines

- Remove fuel lines.



### Note

Catch fuel and dispose of properly.



### Refit fuel lines

- Tighten fuel lines with new Cu O-ring seals.



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## Removing and remounting the oil pump



### Tools

- Commercial tools
- Special tools
- Dial gauge \_\_\_\_\_ 100 400
- Tightening angle dial indicator \_ 101 910

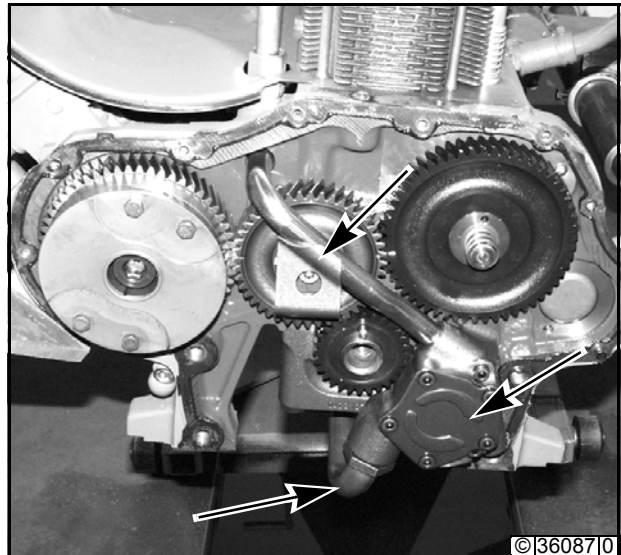


### References

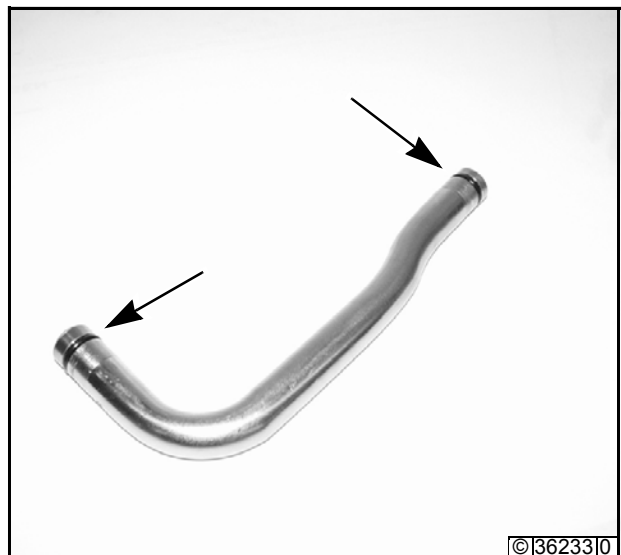
- W 3-8-1
- W 8-4-7

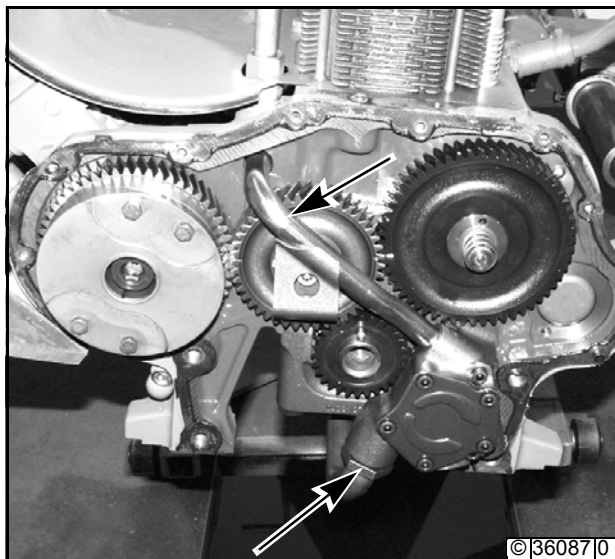
### Remove oil pump

- Set engine to firing TDC cylinder 1.
- Remove front cover
  - see work card **W 3-8-1**.
- Remove oil pan
  - see work card **W 8-4-7**.
- Dismount oil suction pipe.
- Dismount retainer of pressure oil pipe.
- Remove oil pump with pressure oil pipe.



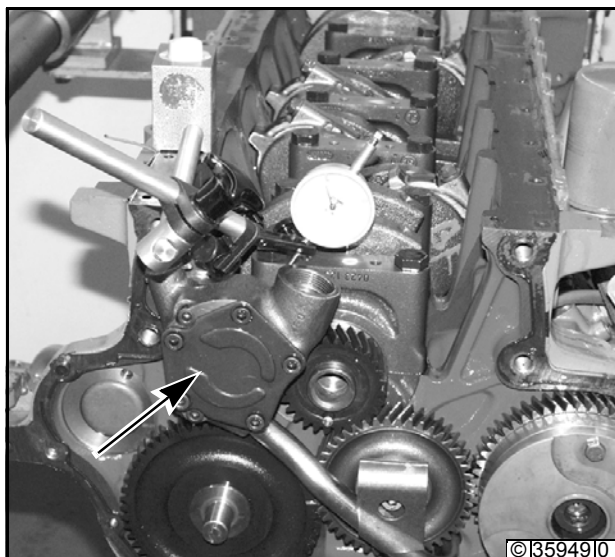
- Fit new O-ring seals.





#### Remount oil pump

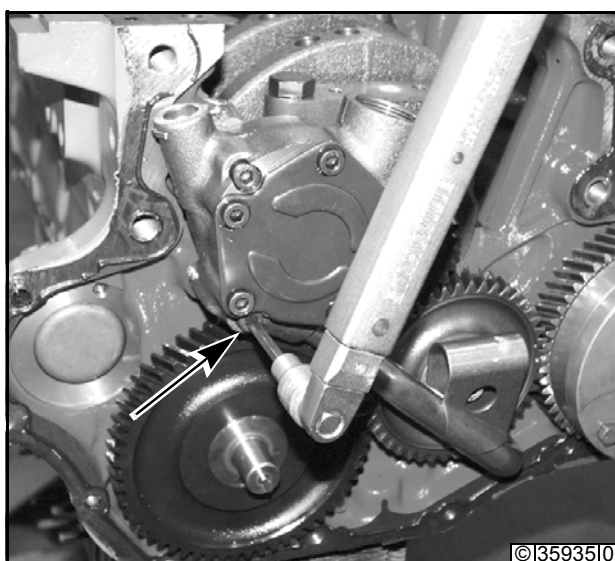
- Refit oil pump with pressure oil pipe and retainer.  
Do up bolts loosely.



#### Note

Turn engine 180°.

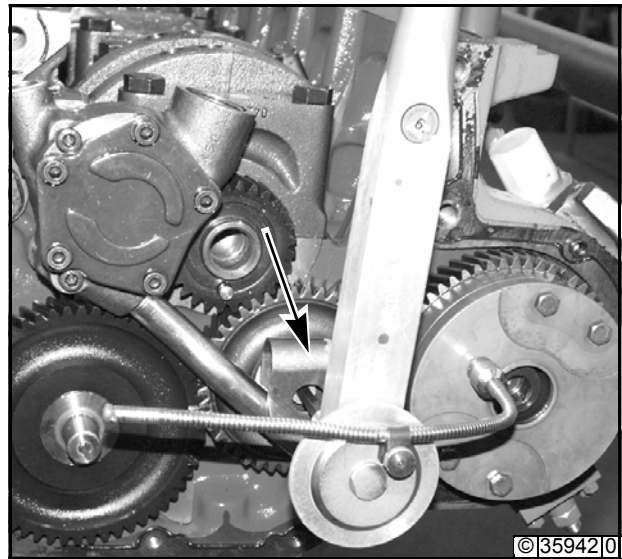
- Adjust backlash by moving the oil pump.



- Tighten bolts on oil pump.



- Tighten bolts on intermediate gear bearing.



- Refit oil suction pipe. Tighten bolts.



- Refit front cover  
- see work card **W 3-8-1**.
- Refit oil pan  
- see work card **W 8-4-7**.





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**Removing and refitting the oil suction pipe****Tools**

- Commercial tools

**References**

- W 3-8-1
- W 8-4-7

**Dismount oil suction pipe**

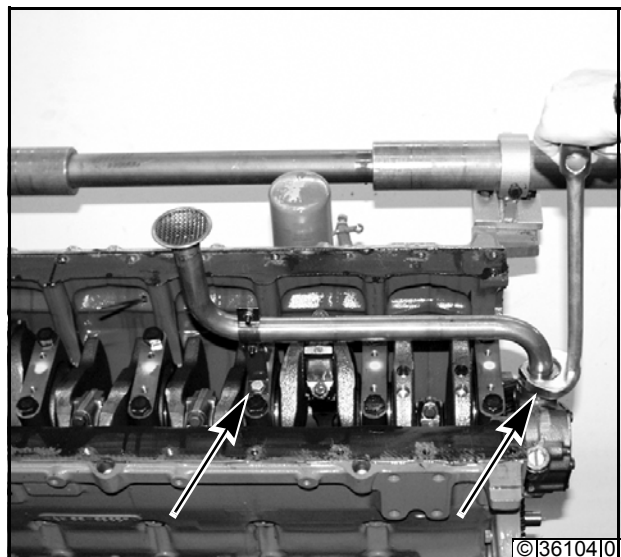
- Remove oil pan
  - see work card **W 8-4-7**.
- Dismount front cover
  - see work card **W 3-8-1**.
- Remove oil suction pipe.

**Remount oil suction pipe**

- Refit oil suction pipe. Tighten bolts.



- Remount front cover
  - see work card **W 3-8-1**.
- Refit oil pan
  - see work card **W 8-4-7**.



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## Removing and remounting the oil pan

**Tools**

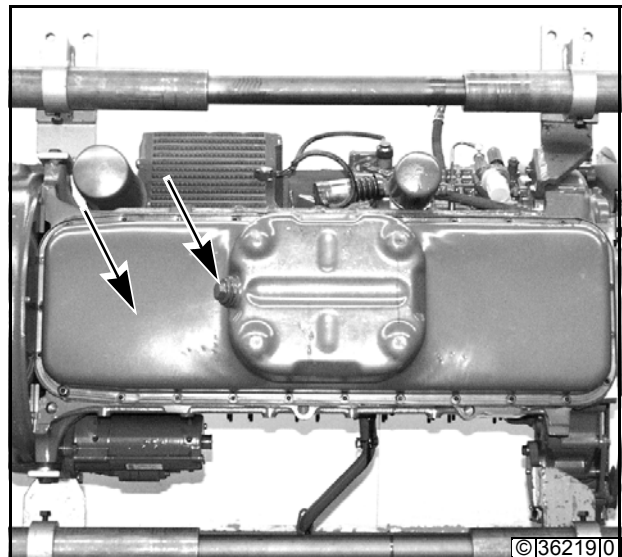
- Commercial tools

**Auxiliary aids**

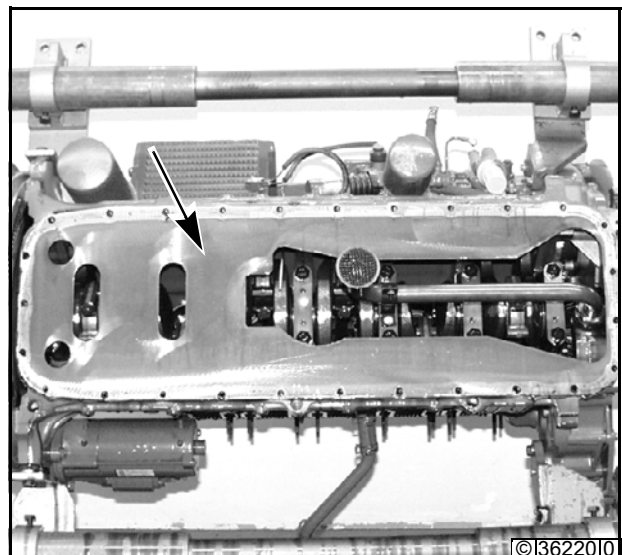
- DEUTZ DW 47

**Remove oil pan**

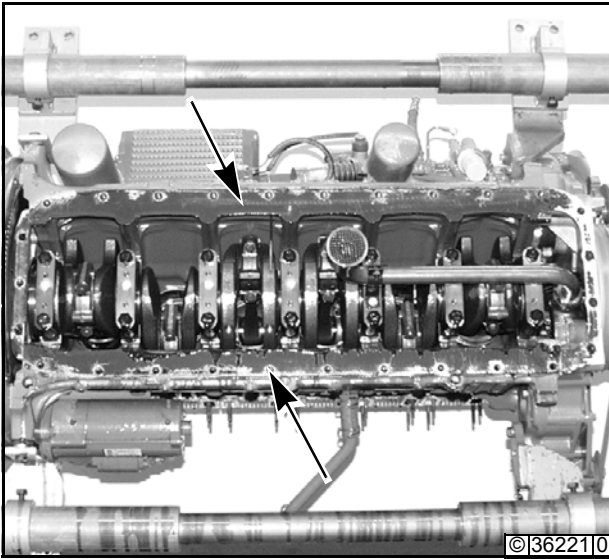
- Drain and catch engine oil, dispose of it properly.
- Remove oil pan.



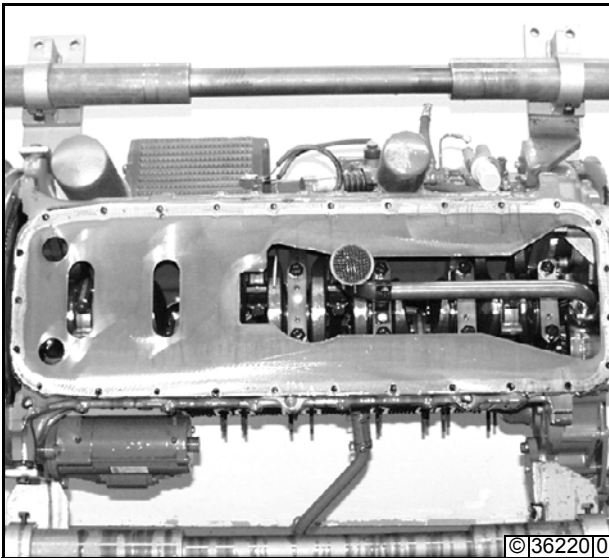
- Dismount oil deflector plate.





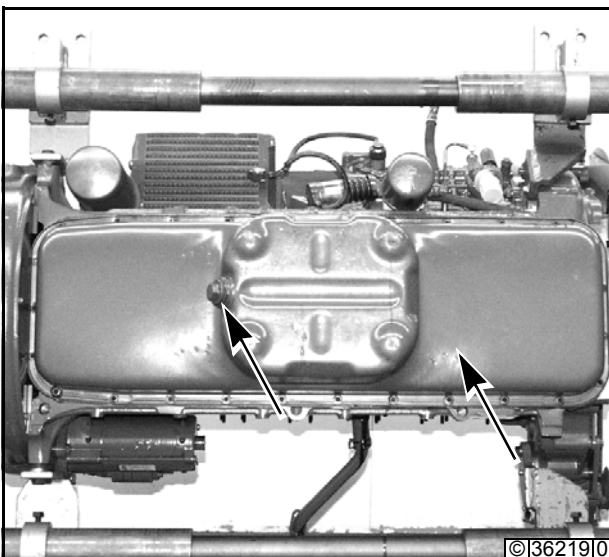


- Clean sealing surfaces.



#### Refit oil pan

- Insert gasket with **DEUTZ DW 47**.
- Remount oil deflector plate with new gasket.



- Insert gaskets with **DEUTZ DW 47**.
- Remount oil pan with new gasket.



- Screw in screw plug on oil pan with new Cu O-ring seal and tighten.



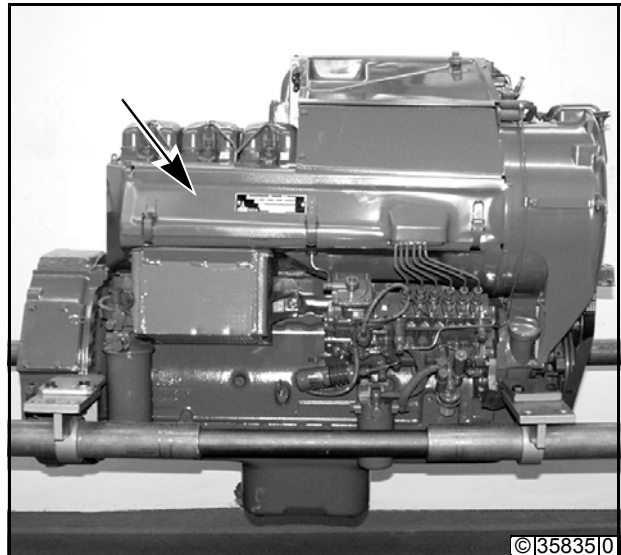
- Fill with engine oil.

**Removing, remounting and cleaning the oil cooler****Tools**

- Commercial tools

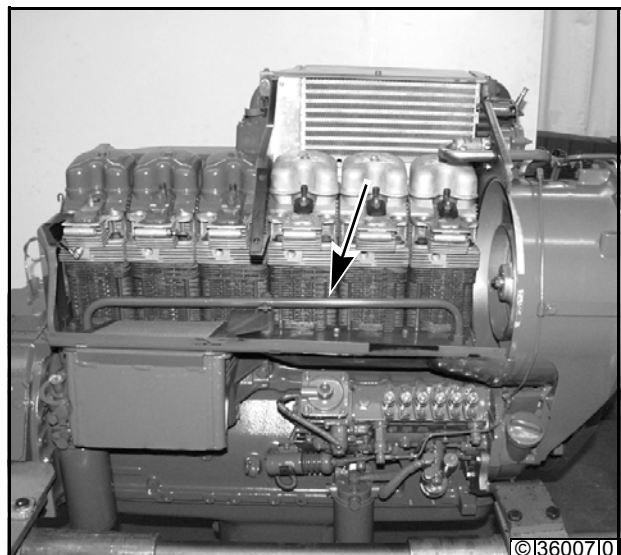
**Remove oil cooler**

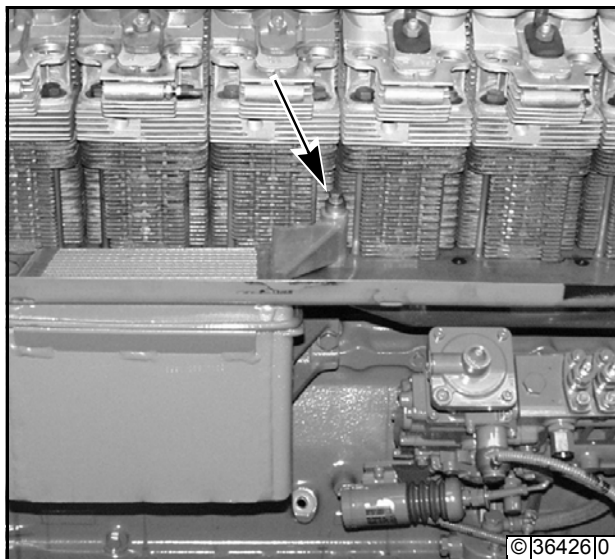
- Remove cooling air guide sheet.

**Note**

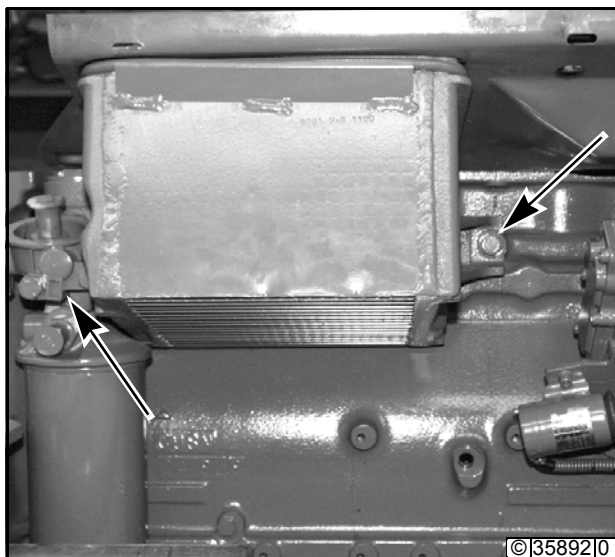
The injection lines und cooling air guide sheets have been removed in this work process to provide a clearer overview.

- Remove oil short-circuit pipe.

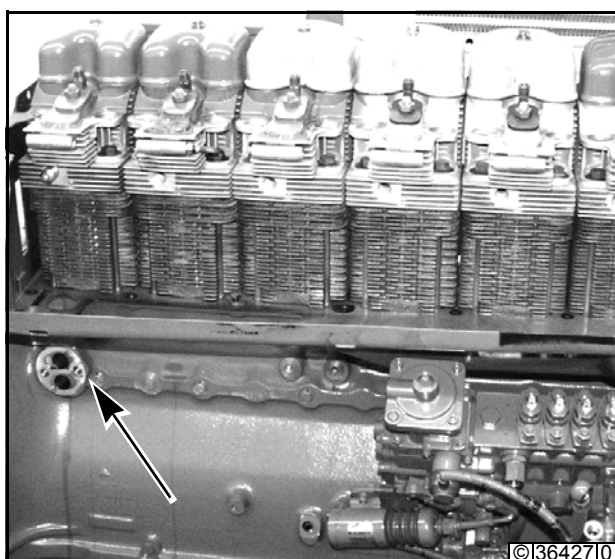




- Remove bolt on oil cooler.



- Remove change-over cock / filter carrier.
- Remove oil cooler and clean.



#### Refit oil cooler

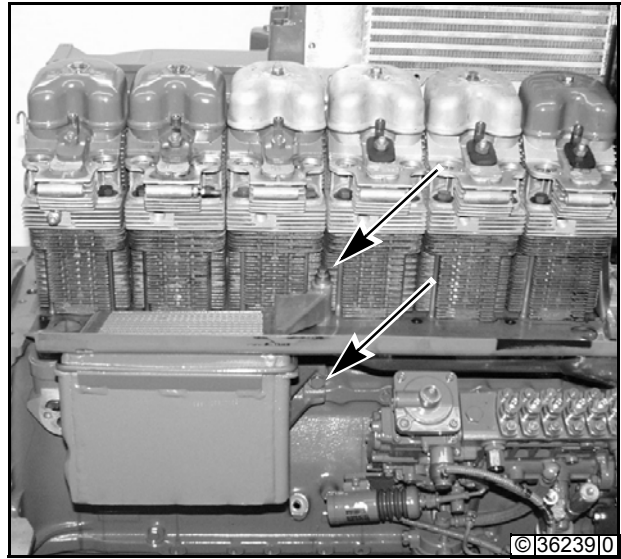
- Insert new gasket.

- Refit oil cooler.



**Note**

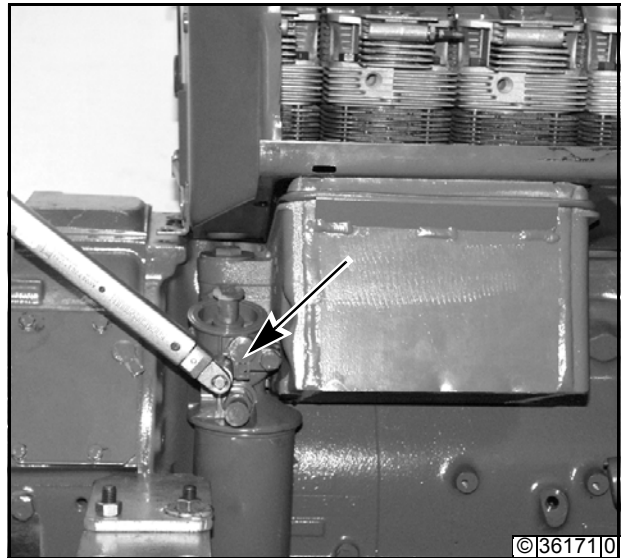
Screw bolts in loosely.



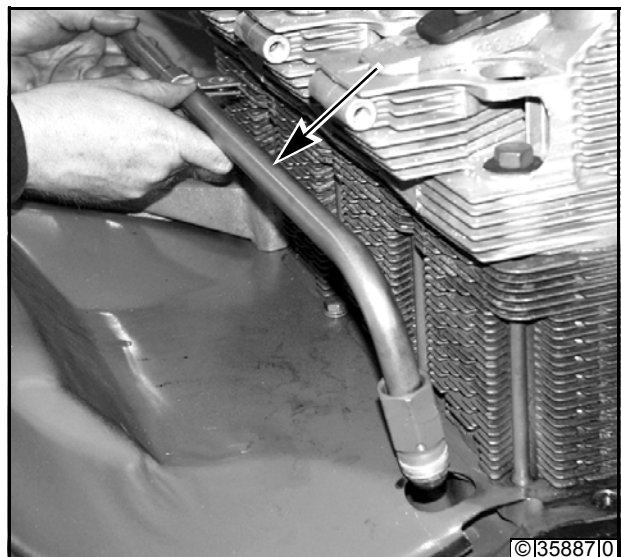
- Refit change-over cock/filter carrier. Tighten bolts



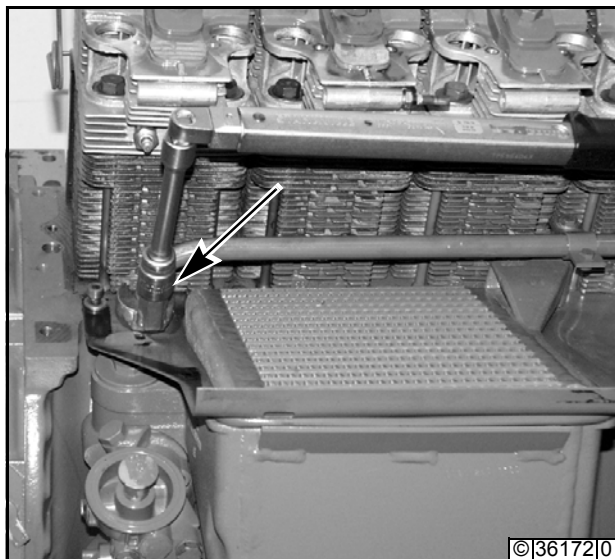
- Tighten bolts on oil cooler.



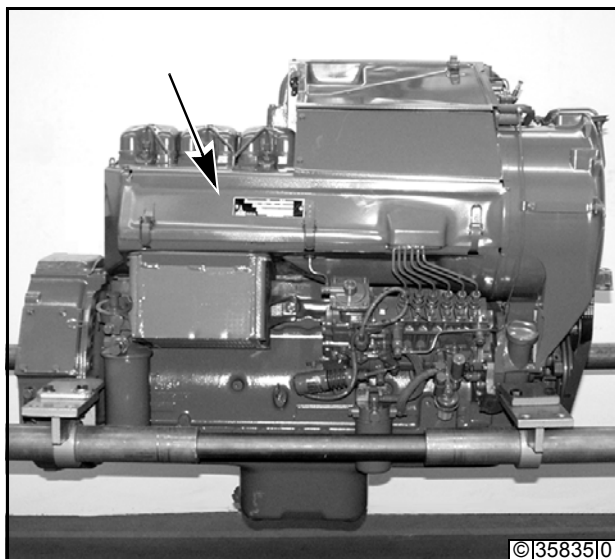
- Refit oil short-circuit pipe.







- Tighten cap nut.



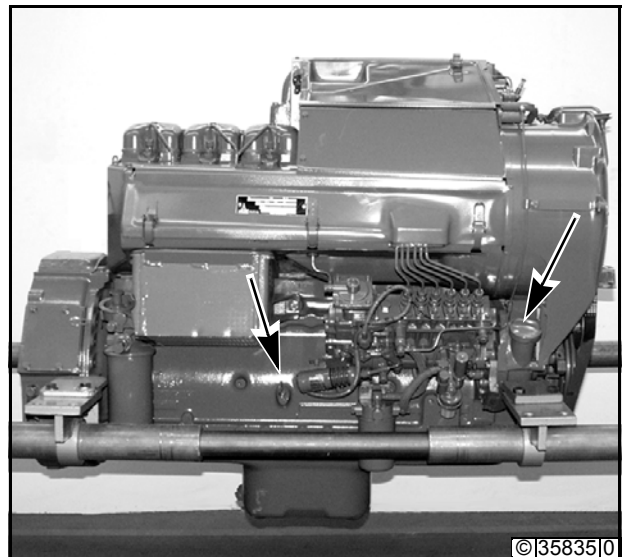
- Refit cooling air guide sheet.

**Removing and remounting the change-over cock / filter carrier****Tools**

- Commercial tools
- Filter key

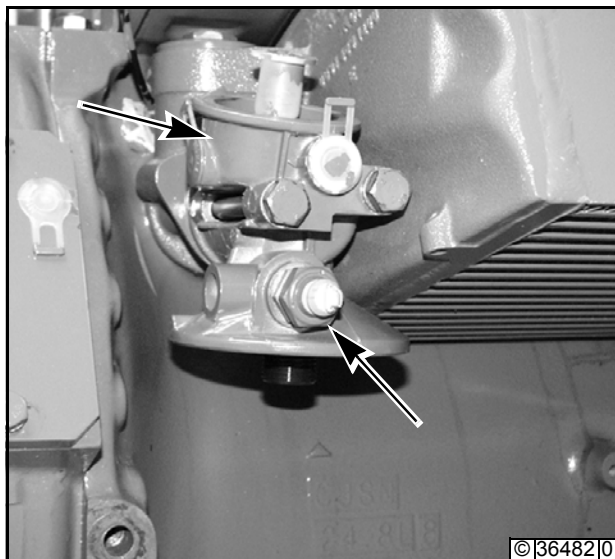
**Remove change-over cock / filter carrier**

- Remove oil filling cap and oil dipstick.



- If necessary, remove oil filter together with filter key.
- Catch engine oil and dispose of properly.



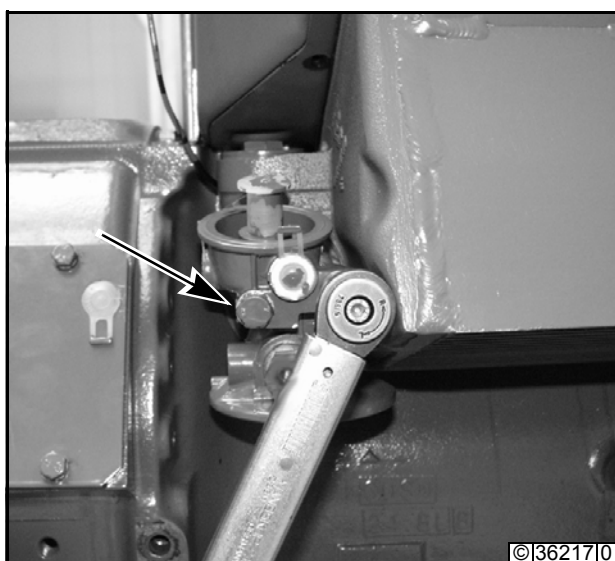


- Remove oil pressure switch.
- Remove change-over cock / filter carrier.



**Refit change-over cock / filter carrier**

- Refit change-over cock / filter carrier with new seal.



- Fasten hex bolts on change-over cock / filter carrier.

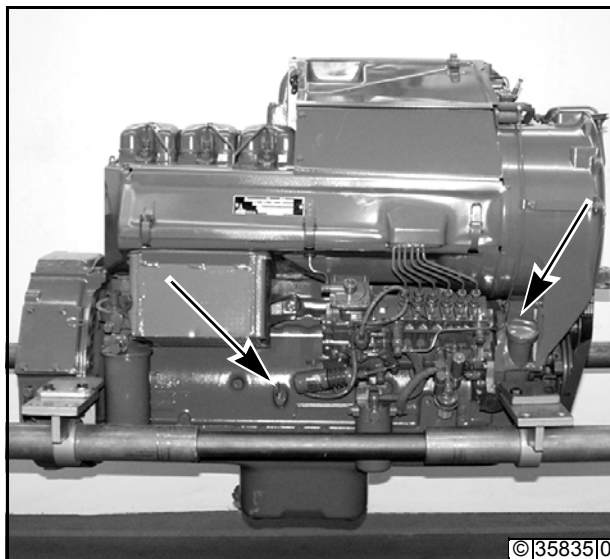


- Lightly oil seal of oil filter and do up loosely.
- Fit oil pressure switch.





- Check level of engine oil, replenish if necessary.
- Refit oil filling cap with new gasket.
- Refit oil dipstick with new sealing ring.





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## Removing and remounting the blower

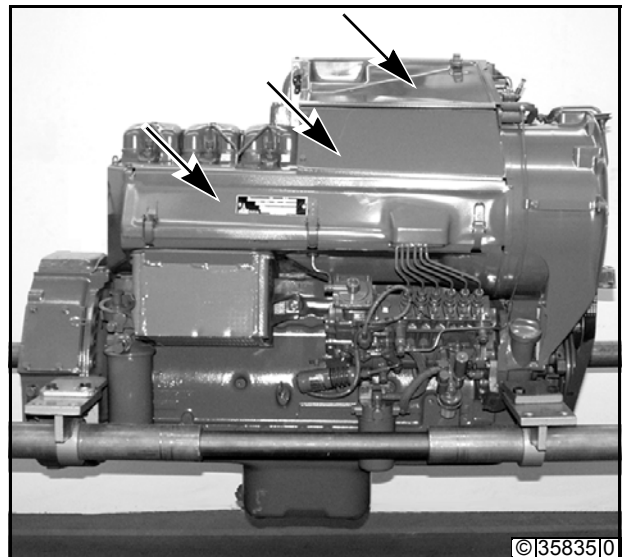


### Tools

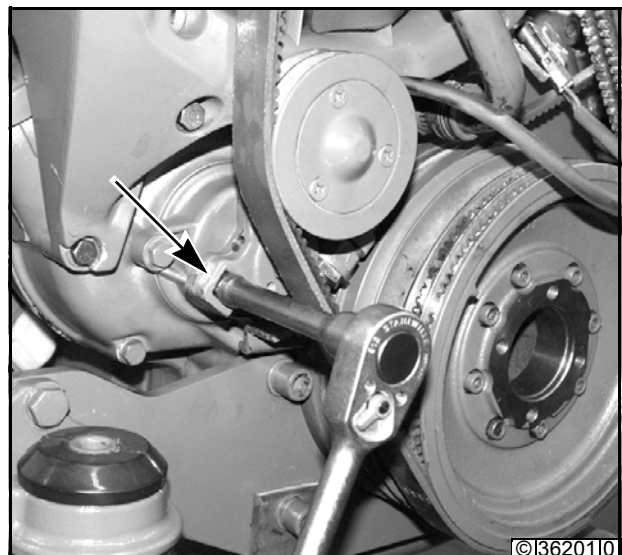
- Commercial tools
- Spring clamping wrench

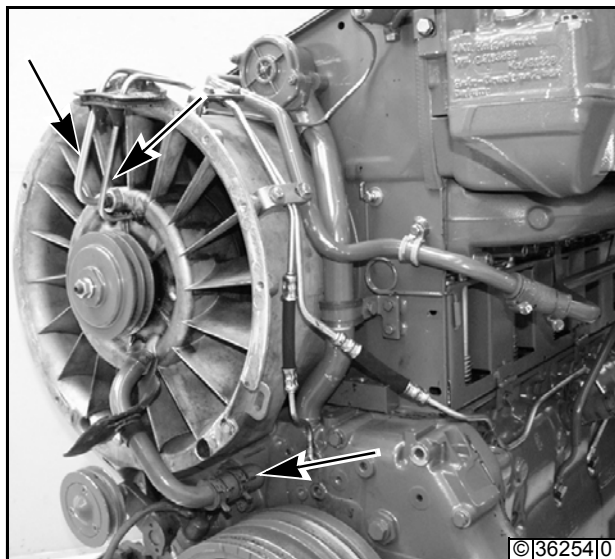
### Remove blower

- Remove cooling air guide sheets.

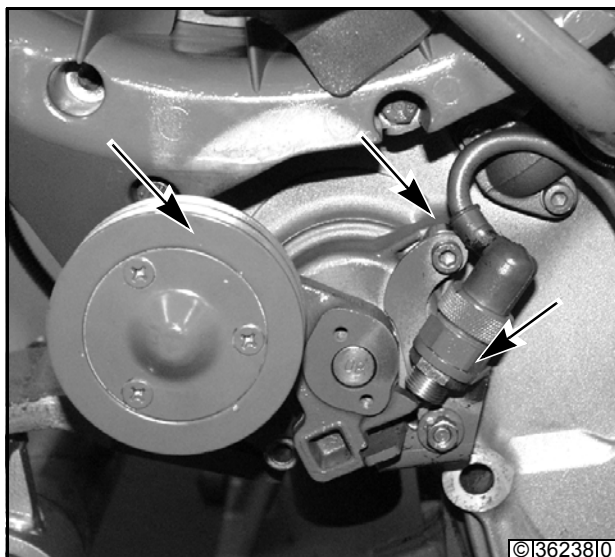


- Tension idler pulley with a suitable tool and remove V-belt.





- Remove control line and breather line together with retainers.
- Catch any escaping engine oil and dispose of properly.
- Remove oil return line, use spring clamping wrench.

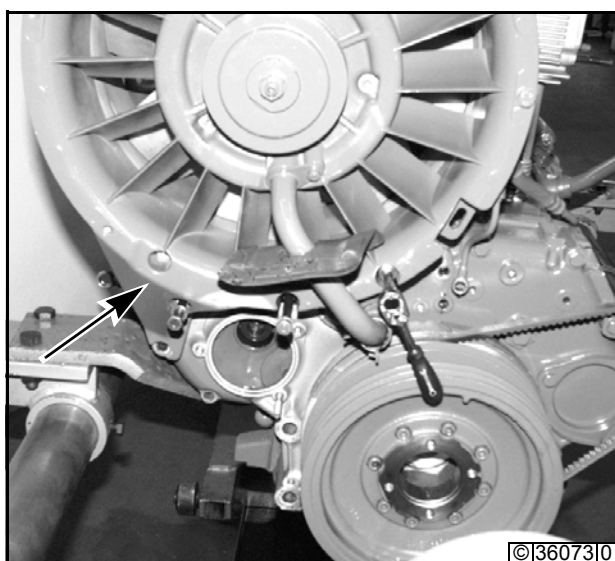


- Remove short-circuit switch and idler pulley.



**Note**

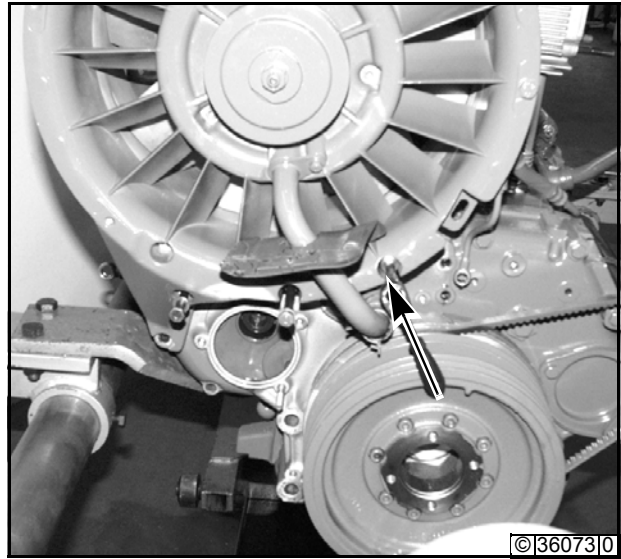
Pay attention to spacer sleeve.



- Remove blower.

**Refit blower.**

- Tighten bolts.

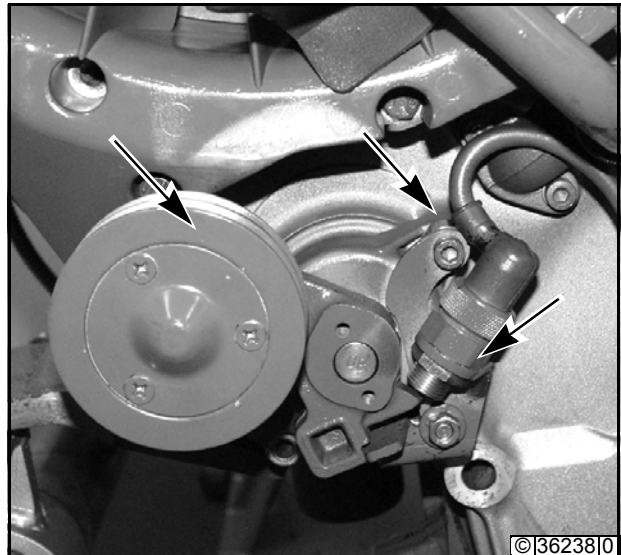


- Refit short-circuit switch and idler pulley.



**Note**

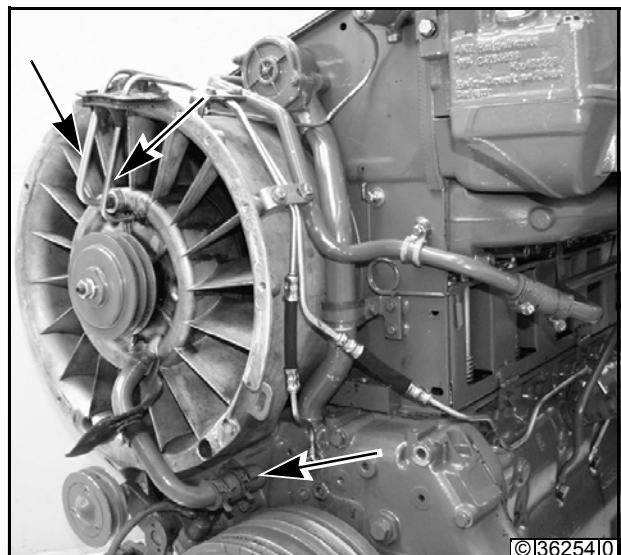
Pay attention to spacer sleeve.



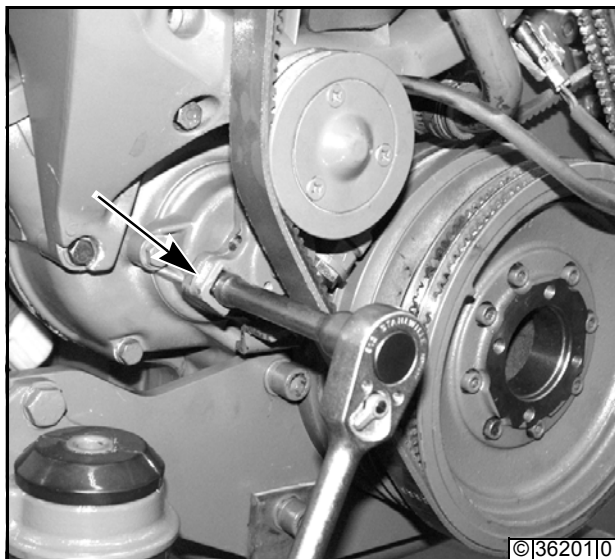
- Fasten control line and breather line together with retainers.



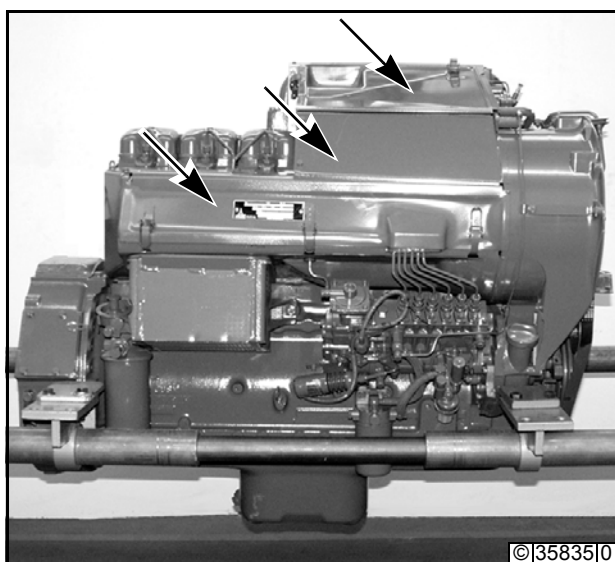
- Refit oil return line, use spring clamping wrench.







- Tension idler pulley with a suitable tool and place on V-belt.



- Refit cooling air guide sheets.

**Dismantling, reassembling and checking the blower****Tools**

- Commercial tools
- Assembly arbor for shaft seal \_\_\_\_\_ 160 260

**Dismantle blower**

- Hold V-belt pulley and bolt together. Undo sealing nut.

**Note**

Clean and oil the bolt thread.



- Unscrew sealing nut.
- Remove V-belt pulley and the O-ring seal lying below.





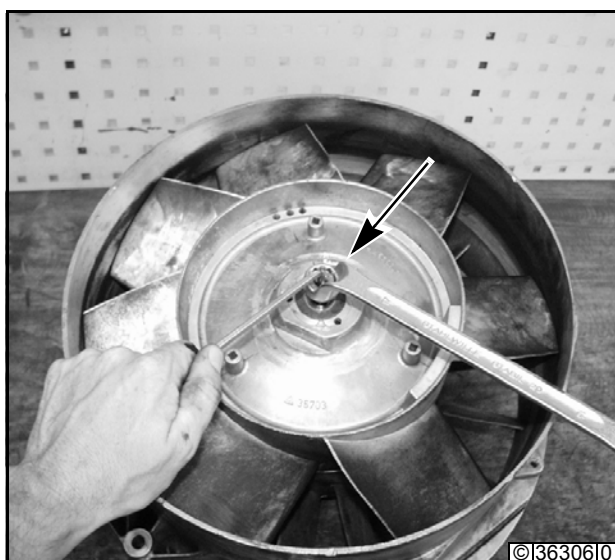


- Hold rotor and bolt together.  
Undo sealing nut.



**Note**

Clean and oil the bolt thread.



- Unscrew sealing nut.

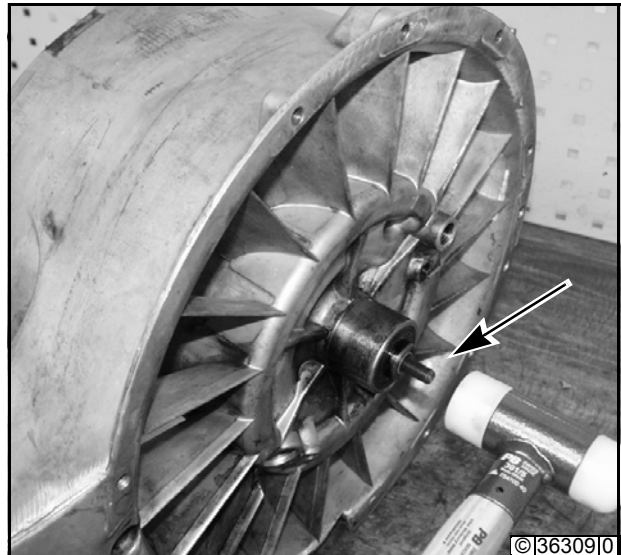


- Remove rotor and the O-ring seal lying below.

- Unscrew bolts.

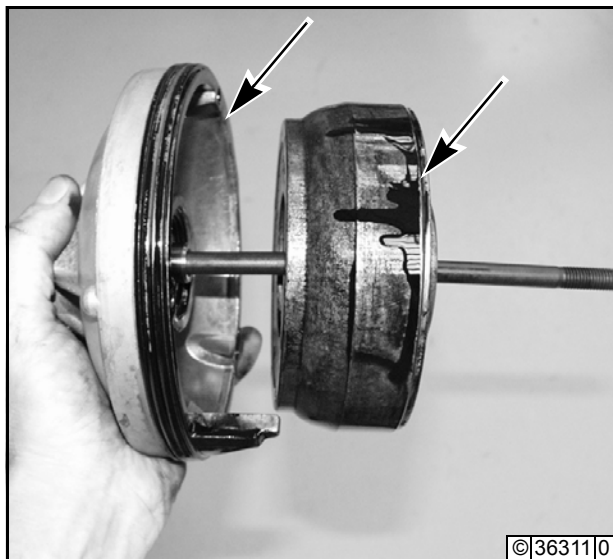


- Undo inner cover by lightly tapping bolt with a plastic hammer.

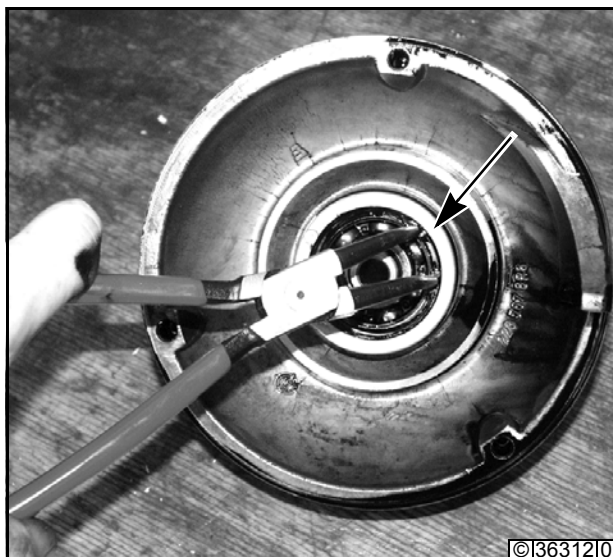


- Take out cover and coupling.

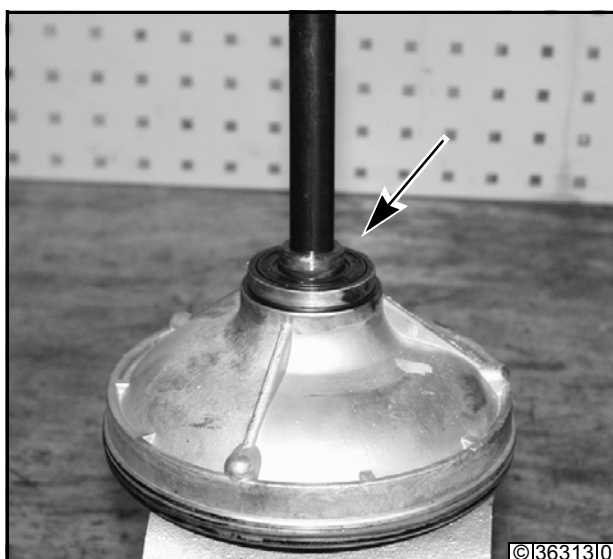




- Separate cover and coupling.



- Separate cover and coupling.
- Remove circlip.



- Press out shaft together with ball bearing.
- Take ball bearing off shaft.



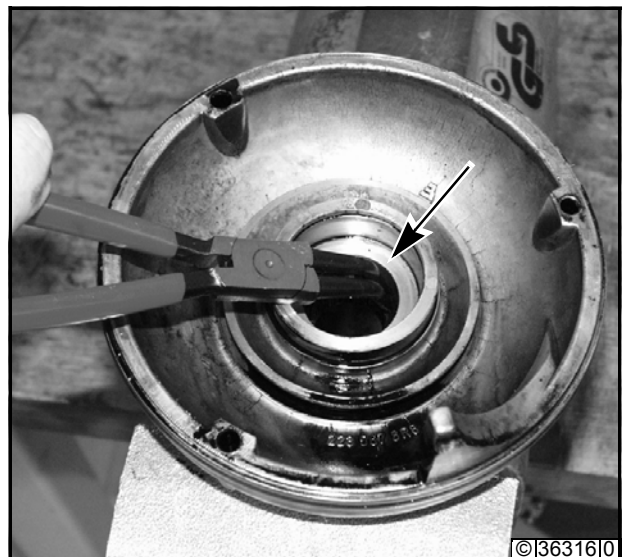
- Prise out shaft seal.

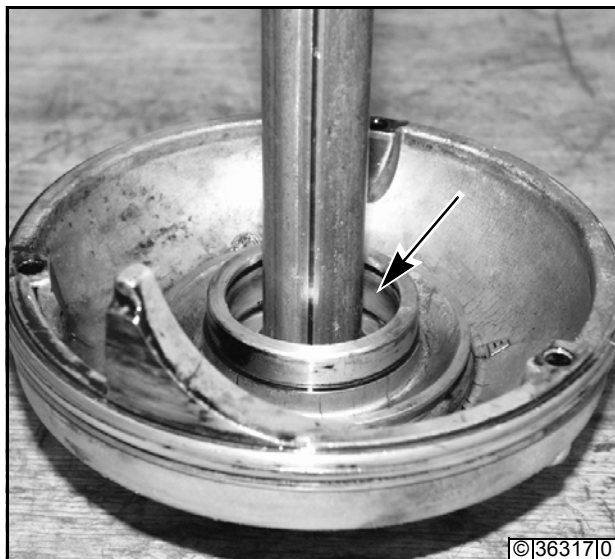


- Remove outer circlip.

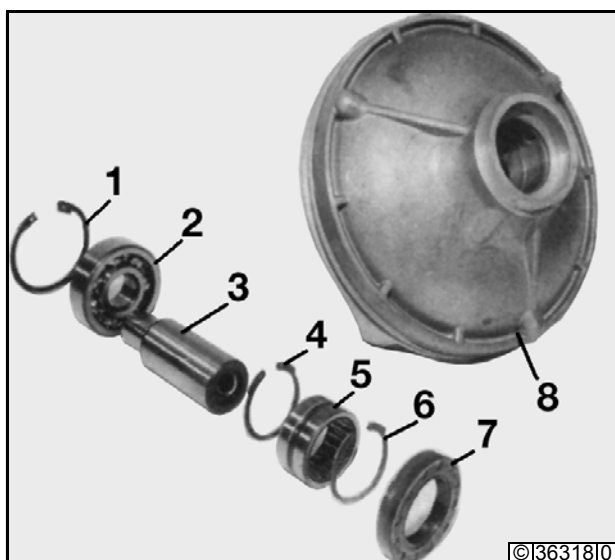


- Remove inner circlip.





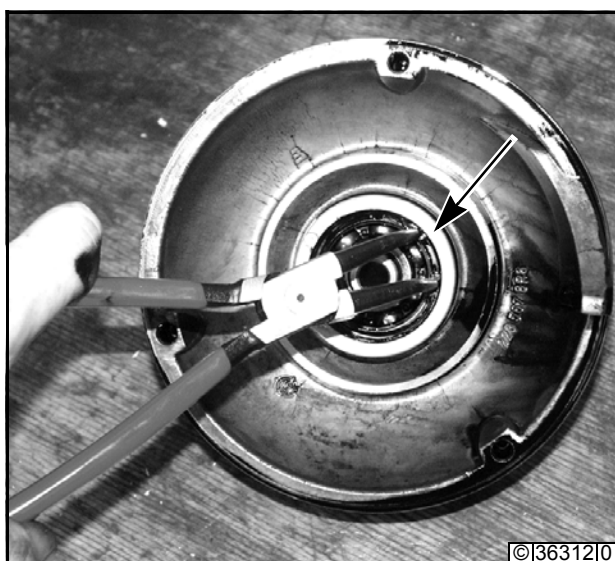
- Press out needle bearing.
- Replace damaged parts.



#### Reassemble blower

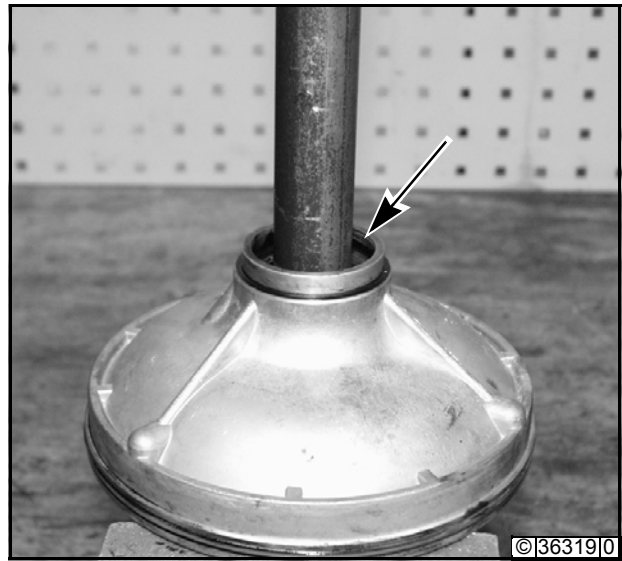
##### ● Assemble cover

- 1 Circlip
- 2 Ball bearing
- 3 Shaft
- 4 Inner circlip
- 5 Needle bearing
- 6 Outer circlip
- 7 Shaft seal
- 8 Cover



- Insert inner circlip.

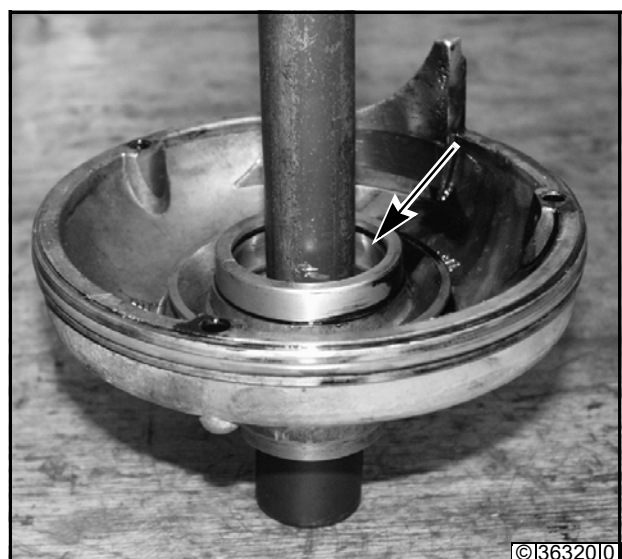
- Press in new needle bearing.



- Insert outer circlip.



- Press in ball bearing over the outer race.







- Insert circlip.



- Press in new shaft seal flush using assembly arbor.



- Guide shaft through shaft seal and press into ball bearing.



**Note**

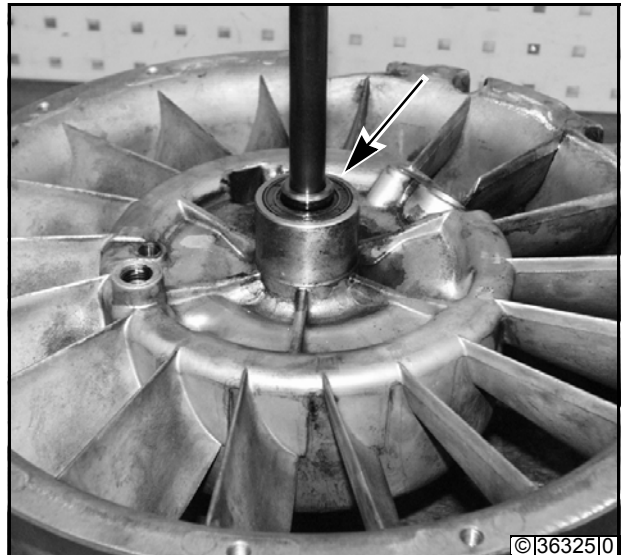
Support cover on inner race of ball bearing.

- Dismantle blower casing

- Remove inner circlip.



- Press out shaft together with ball bearing.
- Remove sleeve.
- Take ball bearing off shaft.



- Prise out shaft seal.





- Remove outer circlip.



- Remove inner circlip.

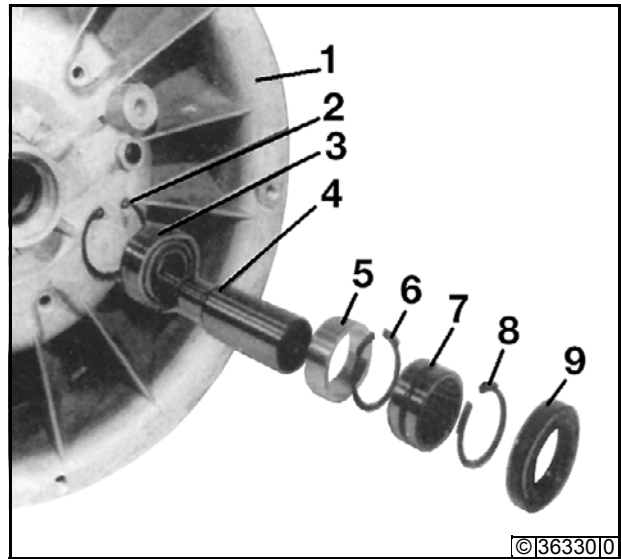


- Press out needle bearing.
- Remove damaged parts.



#### - Assemble blower casing

- 1 Blower casing
- 2 Circlip
- 3 Ball bearing
- 4 Shaft
- 5 Sleeve
- 6 Inner circlip
- 7 Needle bearing
- 8 Outer circlip
- 9 Shaft seal



- Insert inner circlip.

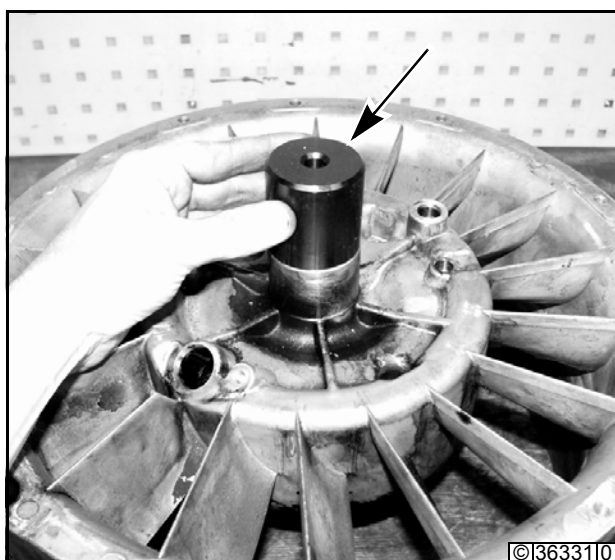


- Press in new needle bearing.





- Insert outer circlip.



- Press in new shaft seal flush using assembly arbor.



- Insert sleeve.

- Press in ball bearing over the outer race.



- Insert circlip.



- Guide shaft through shaft seal and press into ball bearing.



**Note**

Support blower casing on the inner race of the ball bearings.







**Reassemble blower**

- Insert coupling.



- Mount new O-ring seal and coat with lubricant.



- Position cover in blower casing via the threaded bores and insert.



**Note**

Oil deflector boss must face oil return bore.

- Fit cheese-headed bolts with new sealing rings.
- Bring cover to stop by evenly doing up bolts.
- Tighten bolts.



- Fit new O-ring seal.

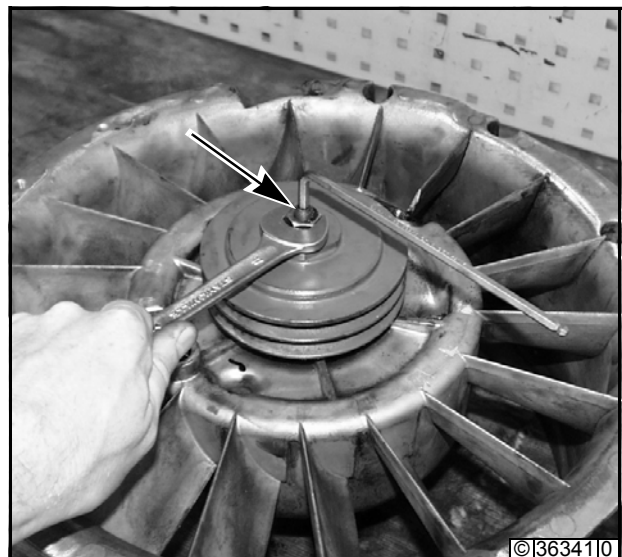


- Bring V-belt pulley into place and screw on new sealing nut.



#### Note

Oil bolt thread.





- Hold V-belt pulley and bolt in place. Tighten sealing nut.

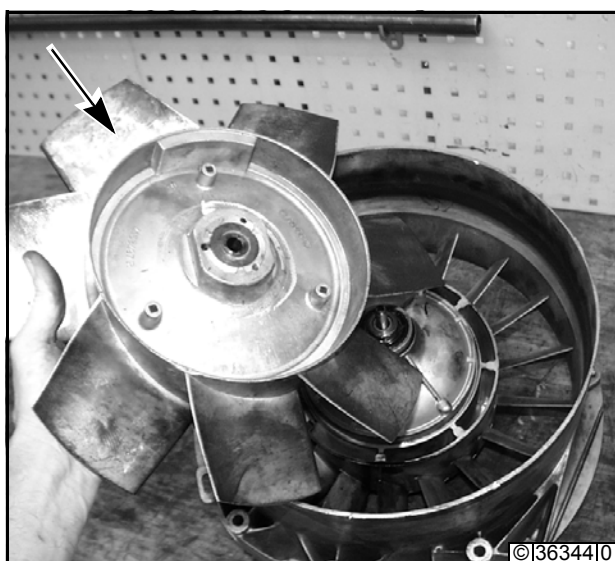


**Note**

For tightening angle apply a 90° mark relative to bolt.



- Fit new O-ring seal.



- Insert rotor.

- Screw on new sealing nut.

**Note**

Oil bolt thread.



- Hold rotor and bolt in place. Tighten sealing nut.

**Note**

For tightening angle apply a 90° mark relative to bolt.



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## Removing and remounting the cooling air ducting

**Tools**

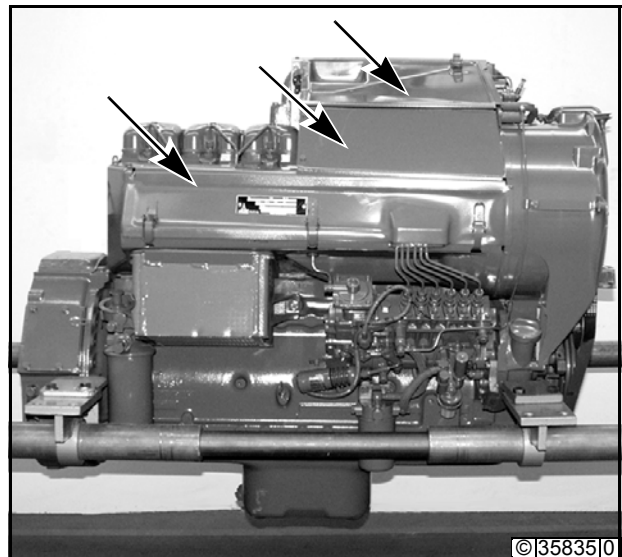
- Commercial tools

**References**

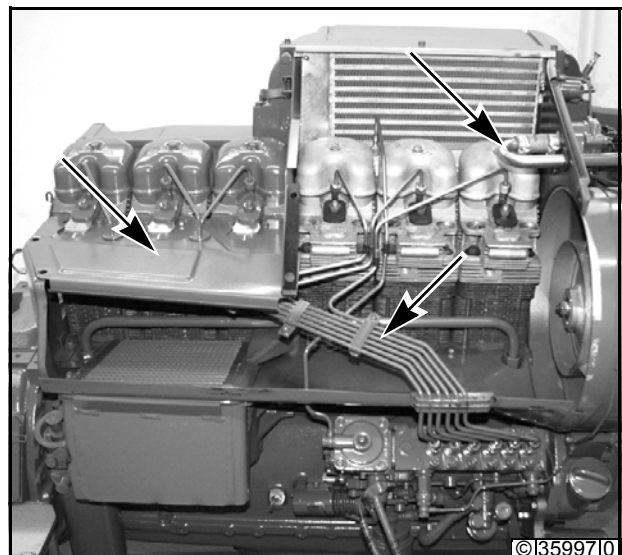
- W 6-1-5  
- W 9-11-1

### Remove cooling air ducting

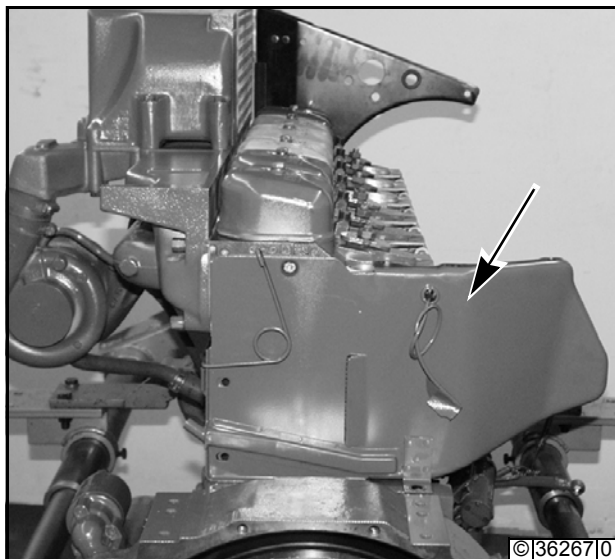
- Remove cooling air guide sheets.



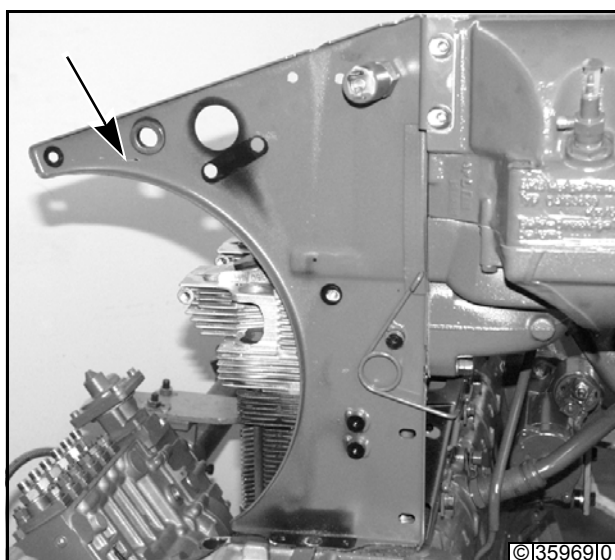
- Dismount injection lines and cooling air guide plate.
- Dismount pipe.
- Remove blower  
- see work card **W 9-11-1**.



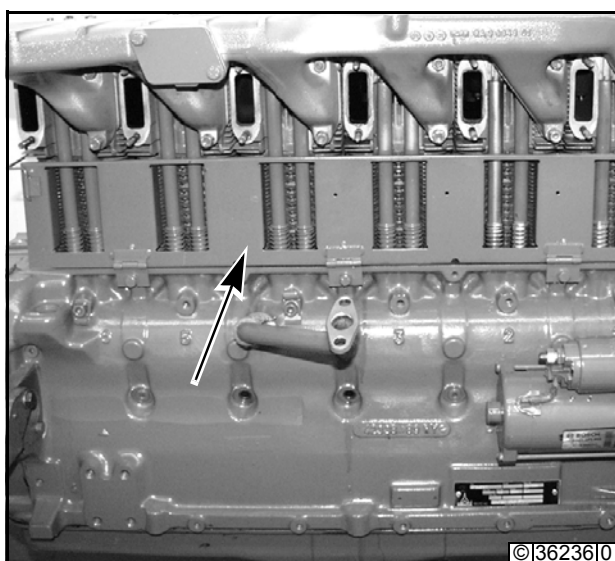




- Dismount stay plate.



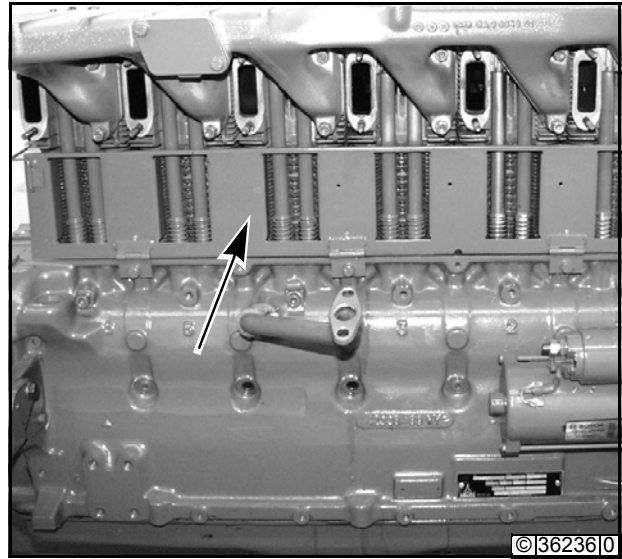
- Dismount stay plate.
- Remove exhaust manifold  
- see work card **W 6-1-5**.



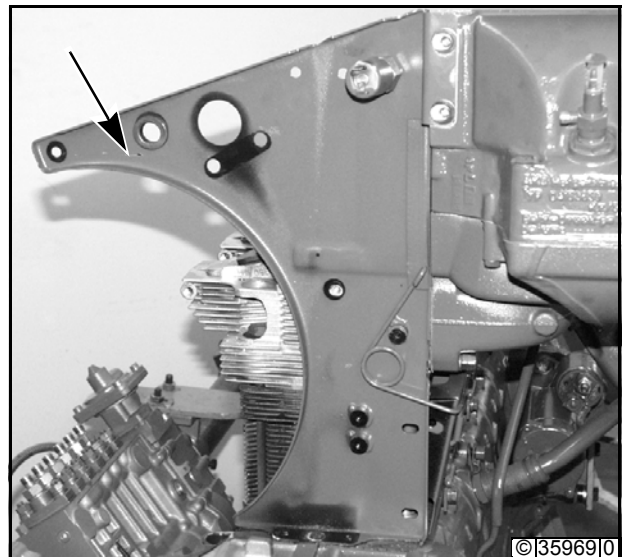
- Dismount shield.

### Remount cooling air ducting

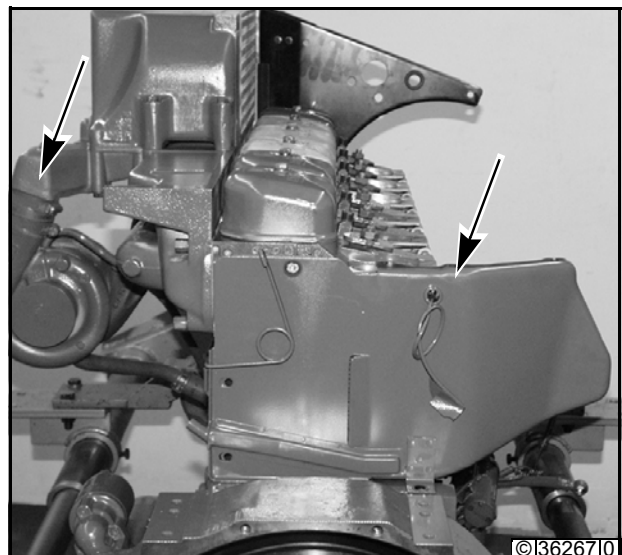
- Remount shield.

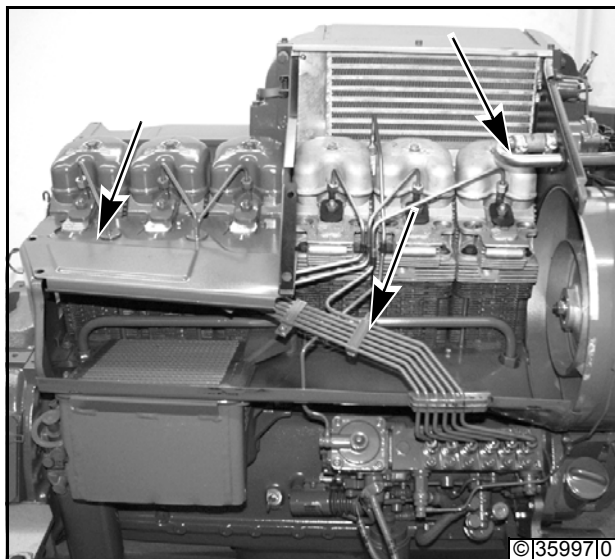


- Remount stay plate.

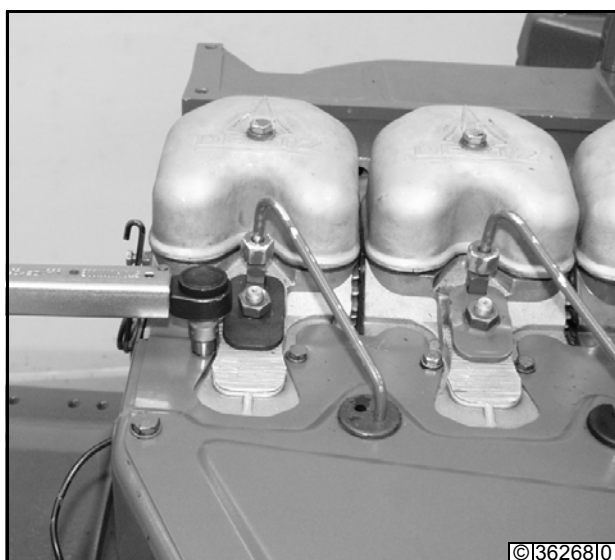


- Remount stay plate.
- Refit exhaust manifold  
- see work card W 6-1-5.

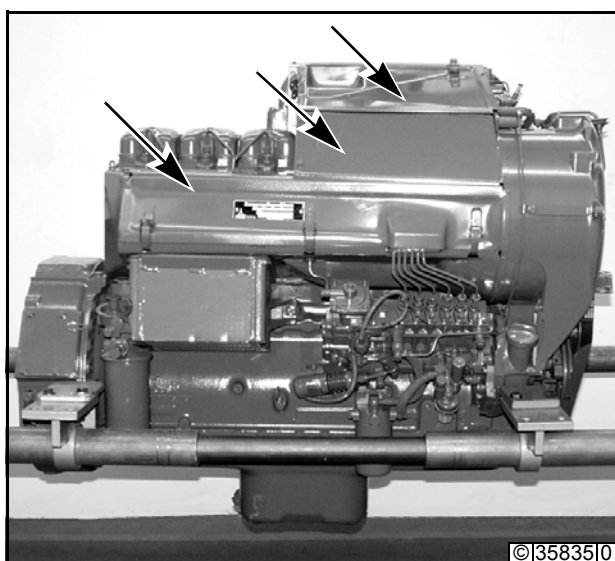




- Remount injection lines and air guide plate.
- Refit blower  
- see work card **W 9-11-1**.
- Remount pipe.



- Insert all bolts.
- Tighten all bolts in the cooling air ducting.



- Refit cooling air guide sheets.

## Removing and remounting the rotary vibration damper



### Tools

- Commercial tools
- Special tools
- Tightening angle dial indicator \_ 101 910
- Retainer \_\_\_\_\_ 143 400



### Auxiliary aids

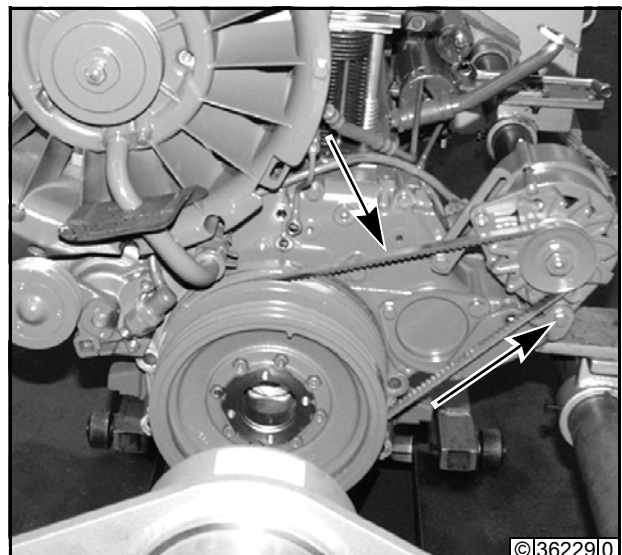
- Molykote-Paste-Rapid

### Remove rotary vibration damper

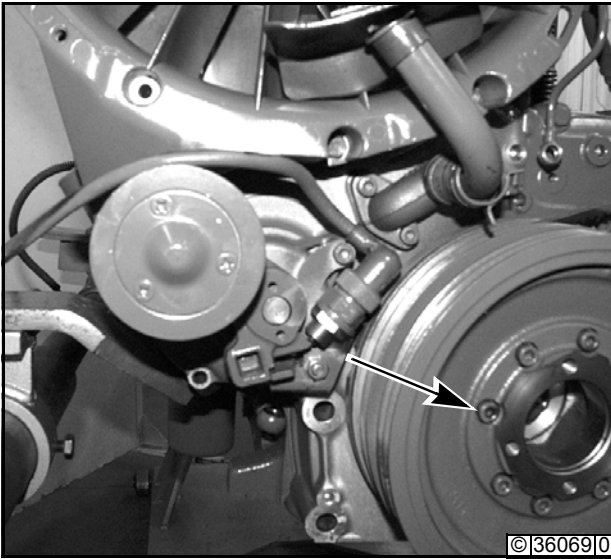
- Tension idler pulley with a suitable tool and dismount V-belt.



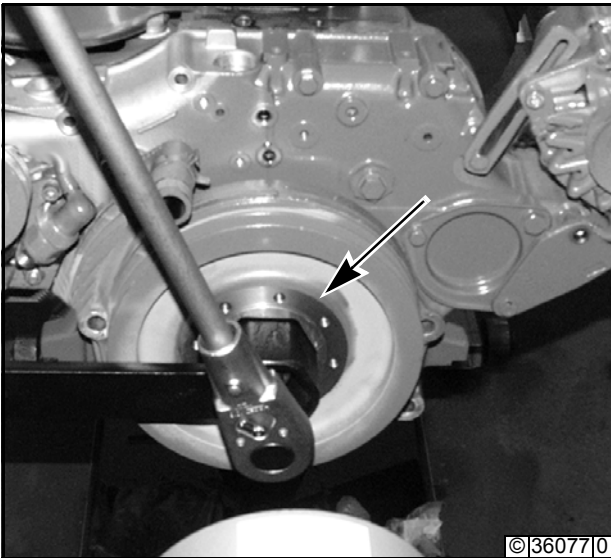
- Undo support and clamping plate from three-phase alternator. Swivel three-phase alternator to the side and remove V-belt.







- Remove V-belt pulley from rotary vibration damper.



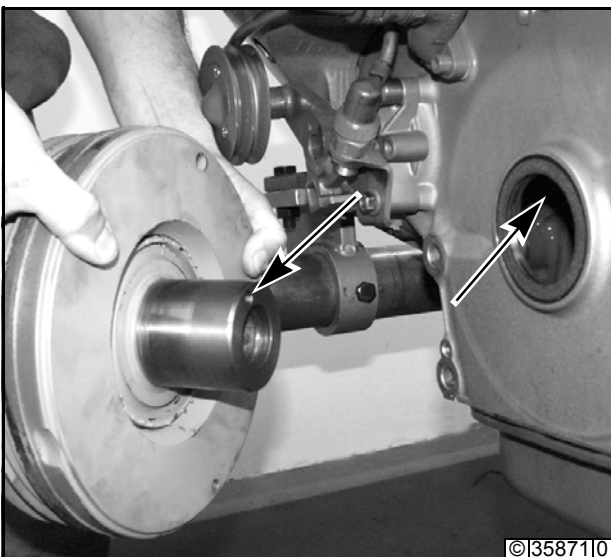
- Fix rotary vibration damper with retainer and undo bolt.



**Note**

Bolt has a left-hand thread.

- Remove rotary vibration damper.



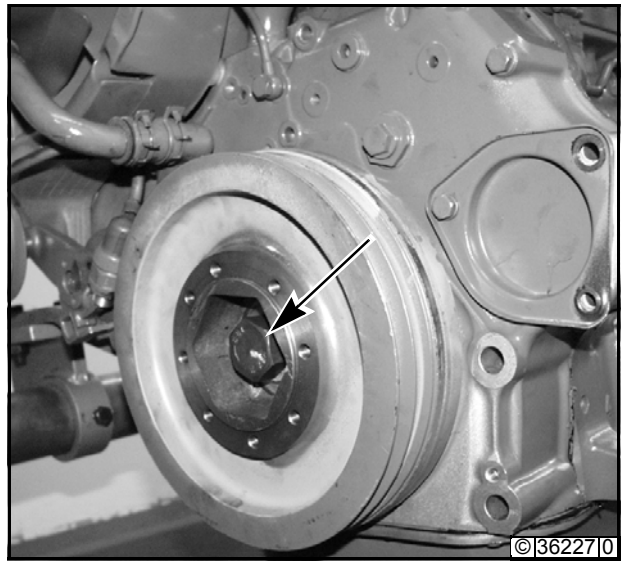
**Refit rotary vibration damper**

- Lightly oil sealing lip of shaft seal.
- Align rotary vibration damper and mount. The bore and alignment pin must coincide.

- Coat thread and head support surface of the bolt with Molykote-Paste-Rapid and insert the bolt.

**Note**

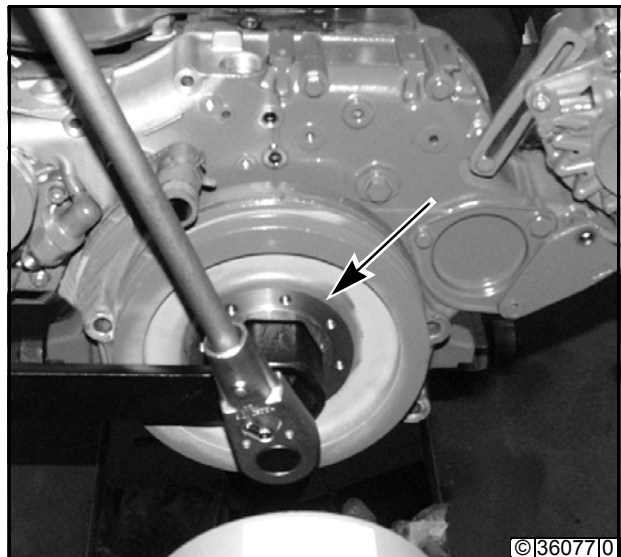
Bolt has a left-hand thread.



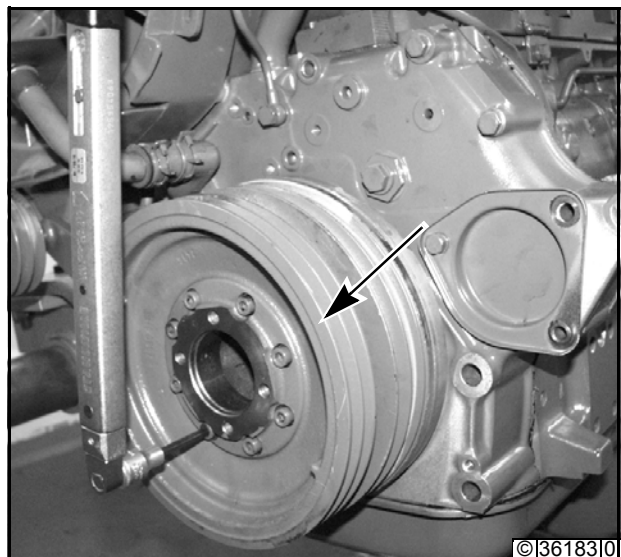
- Fix rotary vibration damper with retainer and tighten bolt.

**Note**

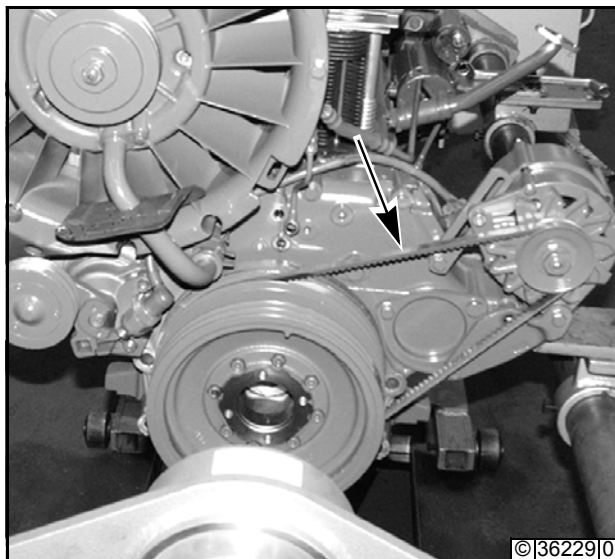
Bolt has a left-hand thread.



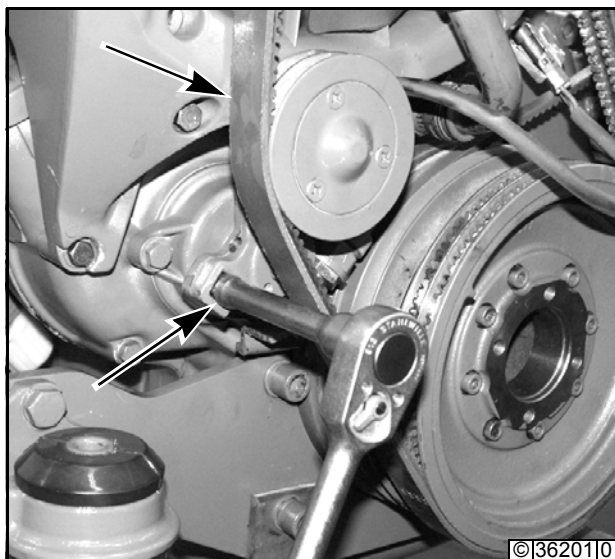
- Fasten V-belt pulley to rotary vibration damper.







- Place on V-belt. Fasten support and clamping plate of three-phase alternator. Check V-belt tension.



- Tension idler pulley with a suitable tool and place on V-belt.

## Checking the rotary vibration damper

**Tools**

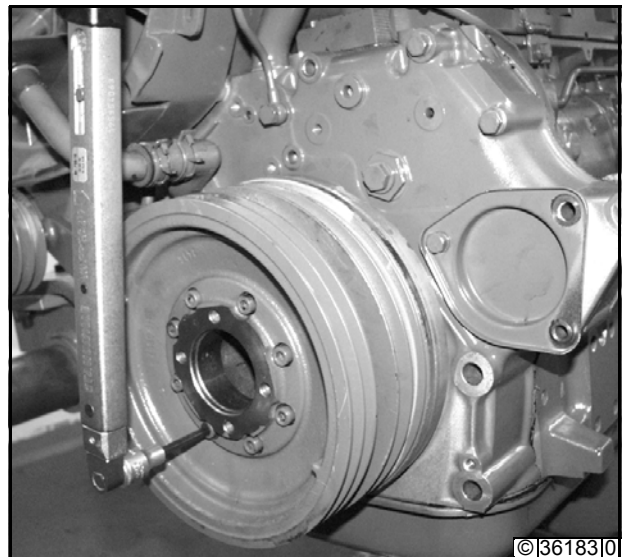
- Commercial tools

**References**

- W 12-1-4

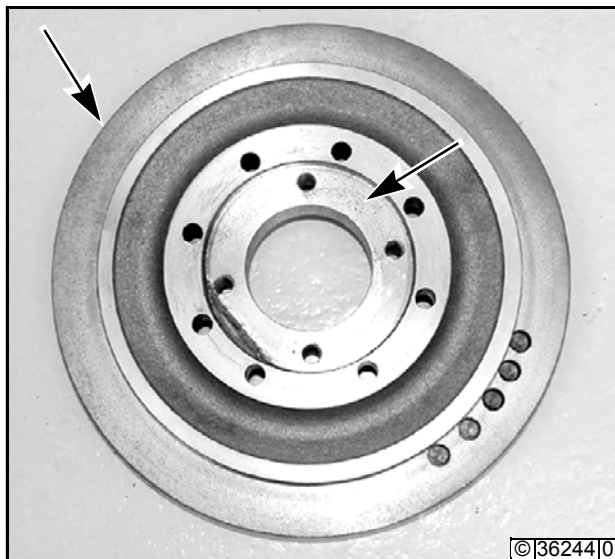
### Check rotary vibration damper

- Remove rotary vibration damper  
- see work card **W 12-1-4**.
- Remove V-belt pulley from rotary vibration damper.



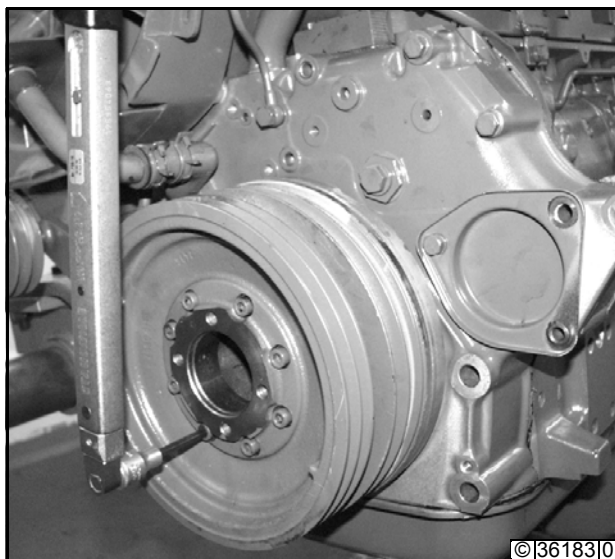
- Visually inspect rotary vibration damper for damage.





**Check V-belt pulley**

- Visually inspect V-belt pulley for damage.



- Refit V-belt pulley to rotary vibration damper.
- Refit rotary vibration damper  
- see work card **W 12-1-4**.

**Disassembly and reassembly of V-belt idler pulley****Tools**

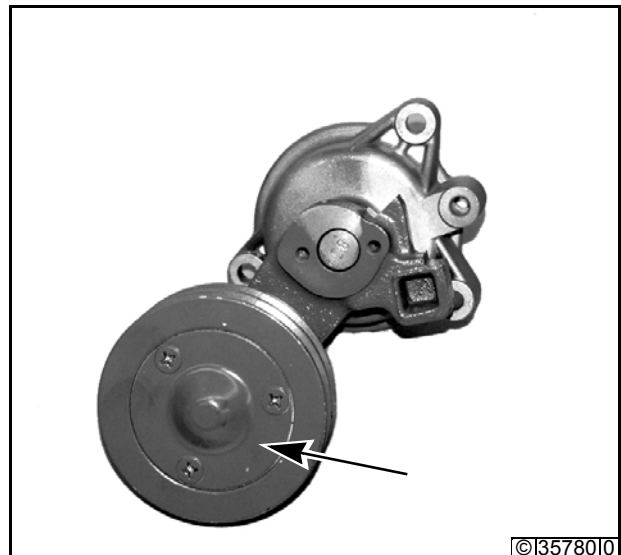
- Special tools
- Assembly arbor for bearing bushes and shaft seal \_\_\_\_\_ 170 130

**References**

- W 12-1-4

**Dismantle V-belt idler pulley**

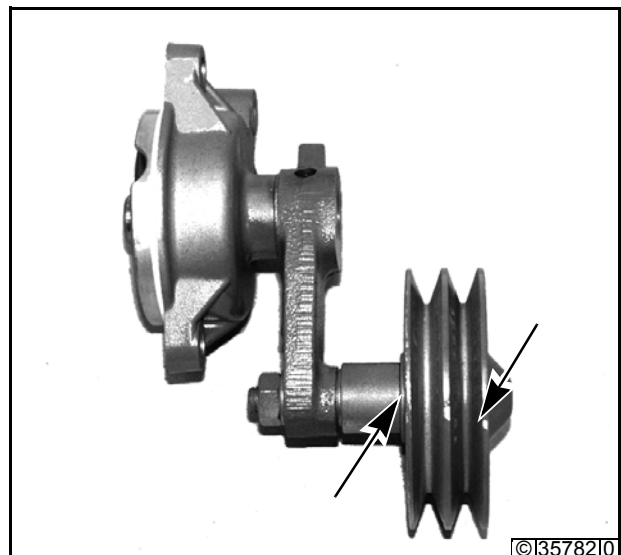
- Dismount V-belt idler pulley  
- see work card **W 12-1-4**.
- Dismount cover.

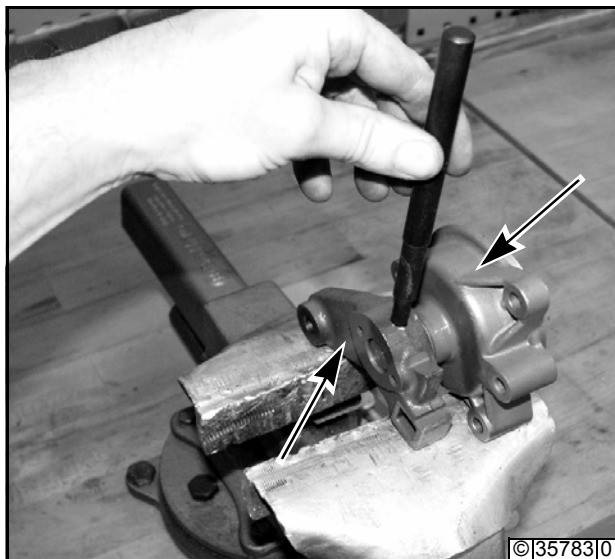


- Dismount V-belt pulley.

**Note**

Pay attention to number and thickness of shims.





- Force out dowel pin.
- Dismount idler pulley lever.



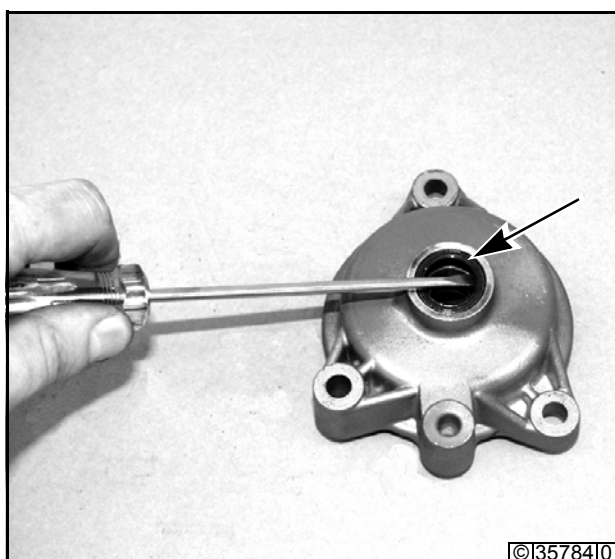
**Note**

Pay attention to number and thickness of shims.

- Pull shaft out of idler pulley housing.



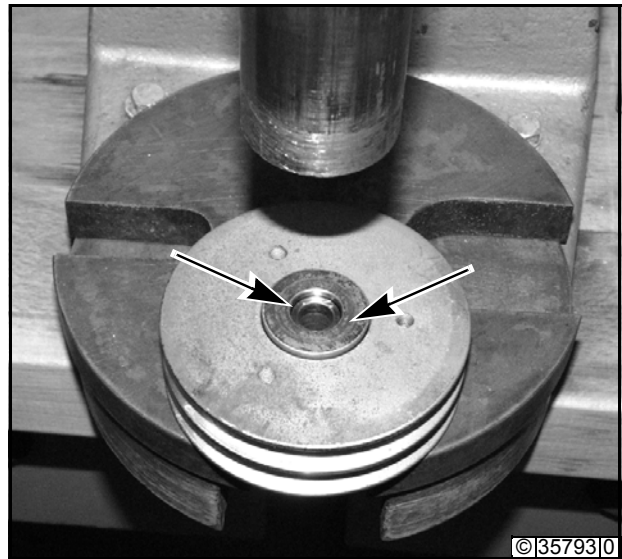
- Dismantle idler pulley housing.
- Inspect all parts, replace if necessary.



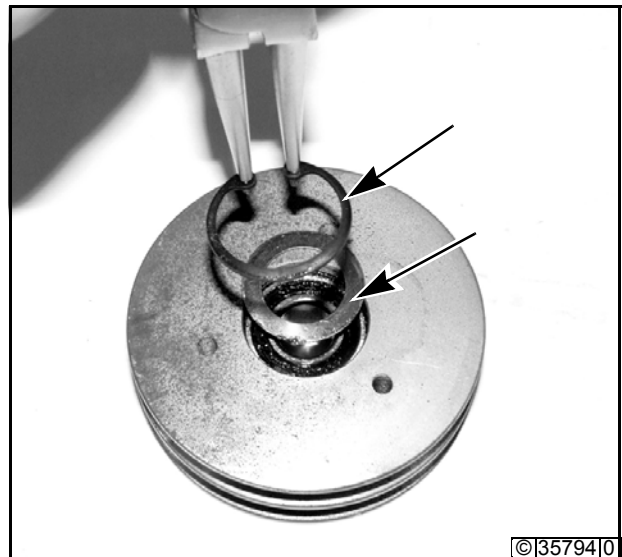
- Prise out shaft seal.



- Press flanged bush out of V-belt pulley and remove ring.

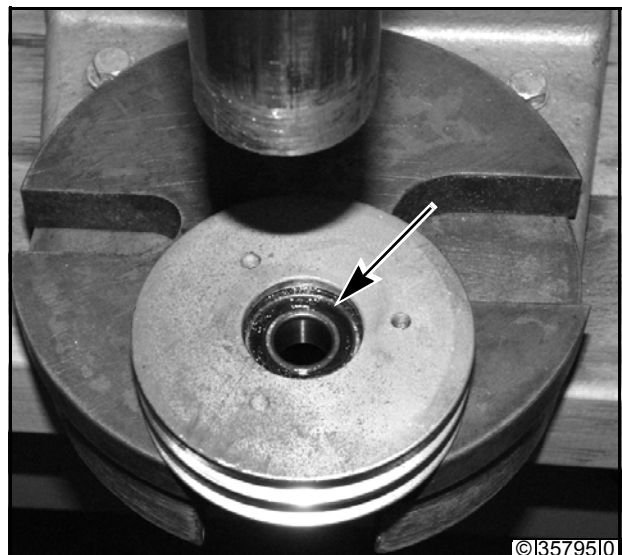


- Take off circlip and washer.
- Push out ball bearing.

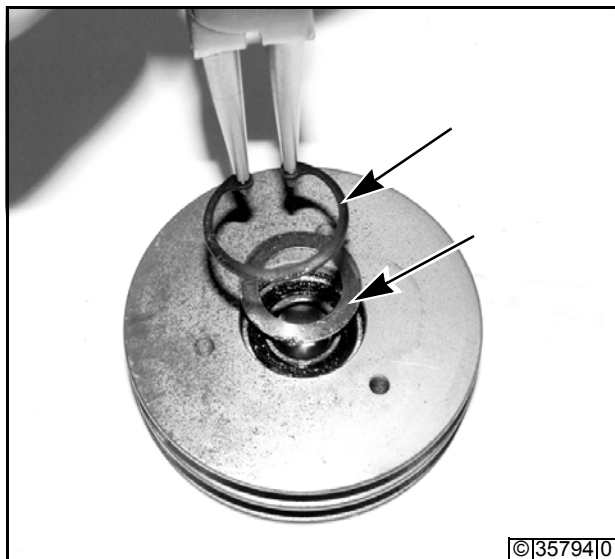


#### Reassemble V-belt idler pulley

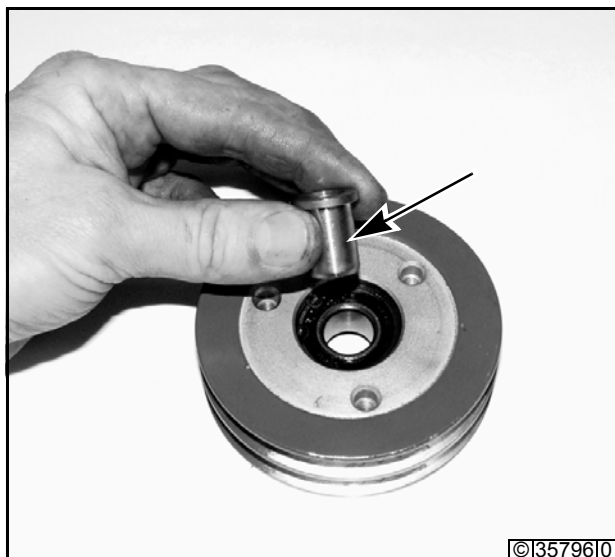
- Push in ball bearing as far as it will go.







- Insert washer and circlip.



- Insert flanged bush into ball bearing.



- Position ring over flanged bush.



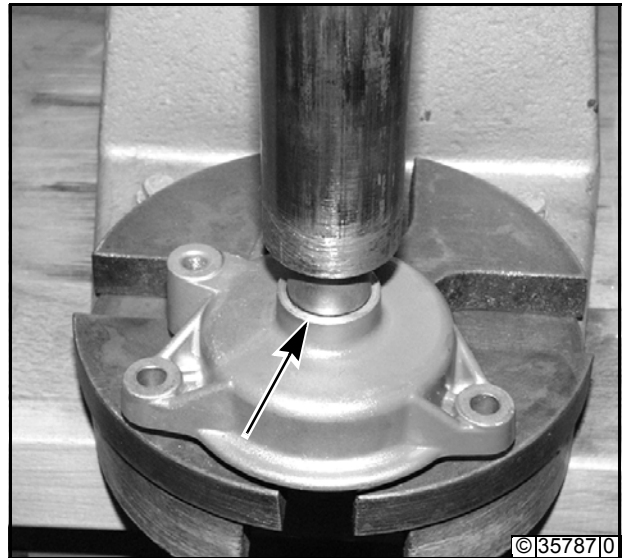
**Note**

Centering of ring must point towards ball bearing.

- Press out bearing bushes with spacer ring. Use the assembly arbor for this purpose.

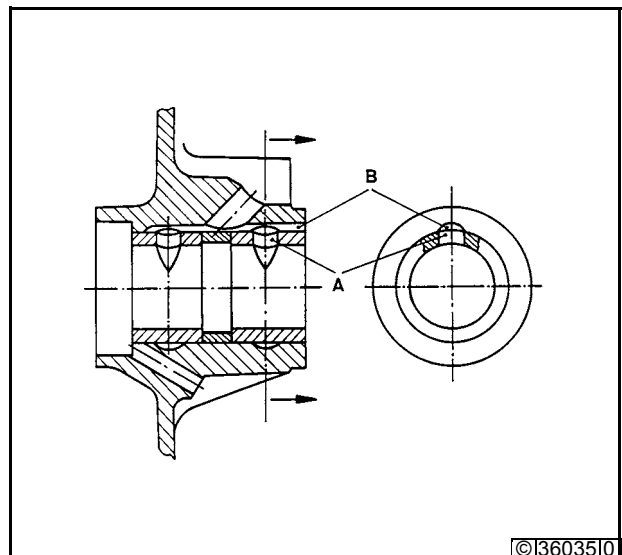


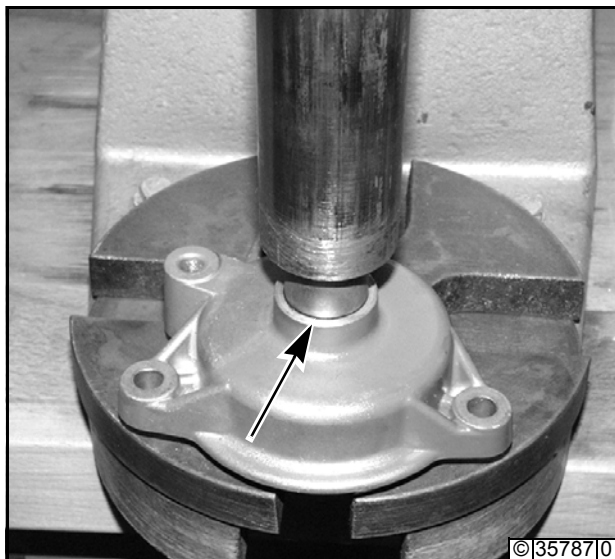
- Press in new bearing bushes with spacer ring, see schematic. Use the assembly arbor for this purpose.



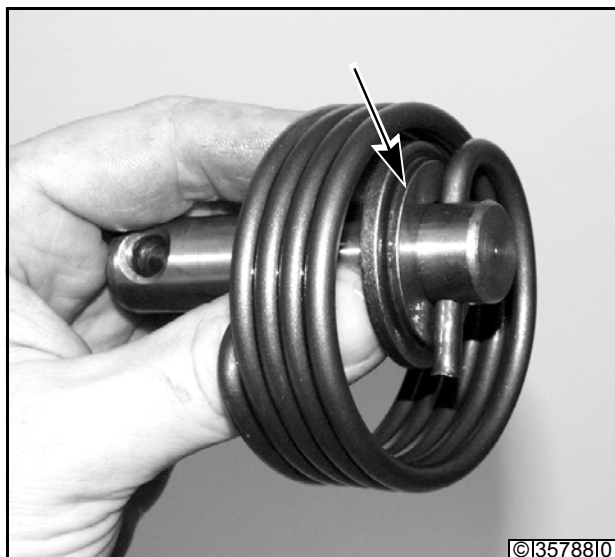
### Note

Schematic for pressing-in bearing bushes:  
The oil bores "A" must be in line with oilduct "B". The inside bearing bush must be flush. There must be no axial end float between spacer ring and bearing bushes.





- Press in new shaft seal with assembly arbor.

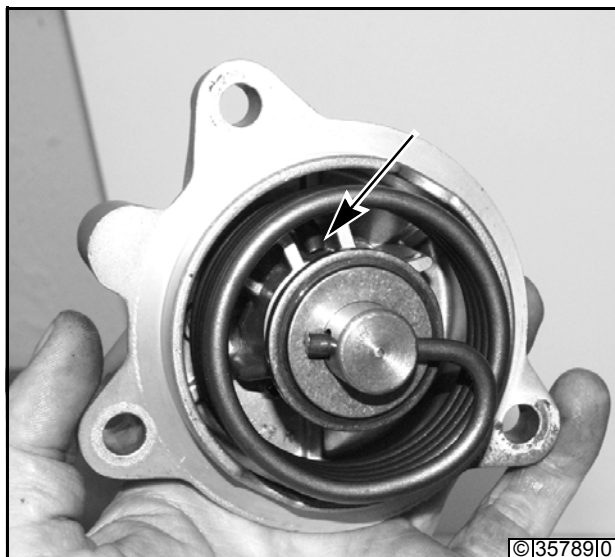


- Assembly shaft together with disc and spring.



**Note**

Centering of the disc must point towards idler pulley housing. Centering serves to fix the shaft.



- Oil the sealing lip of shaft seal and shaft. Install assembled shaft in idler pulley cover and fix with short spring end.

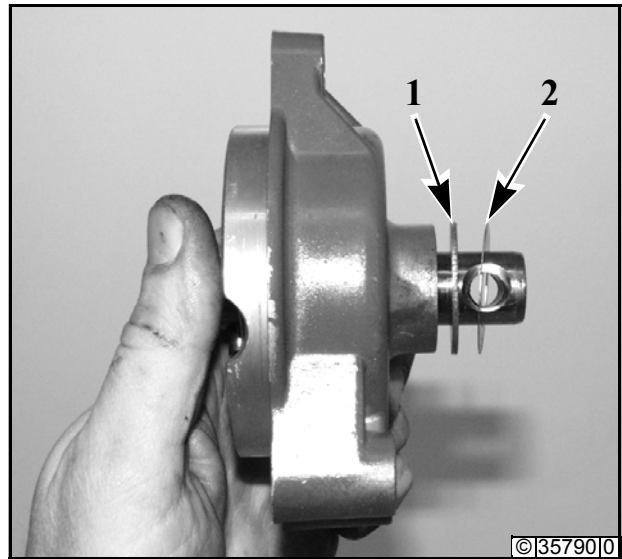
- Slide on stop washers.

- item 1 stop washer coated on one side
- item 2 steel washer



**Note**

Coated side of item 1 must point towards steel washer, item 2.

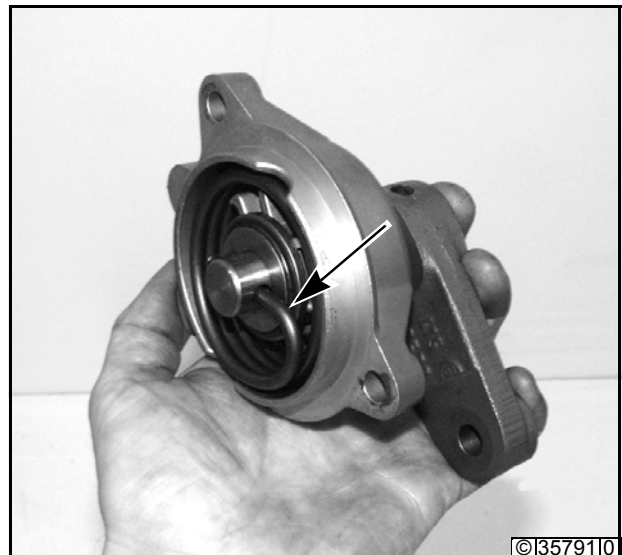


- Fit idler pulley lever.



**Note**

Pay attention to position towards long spring end.



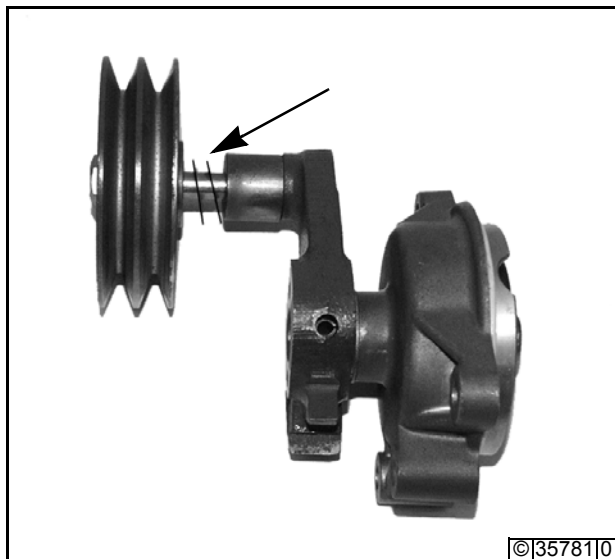
- Force in dowel pin.



**Note**

Ensure bores are in line.





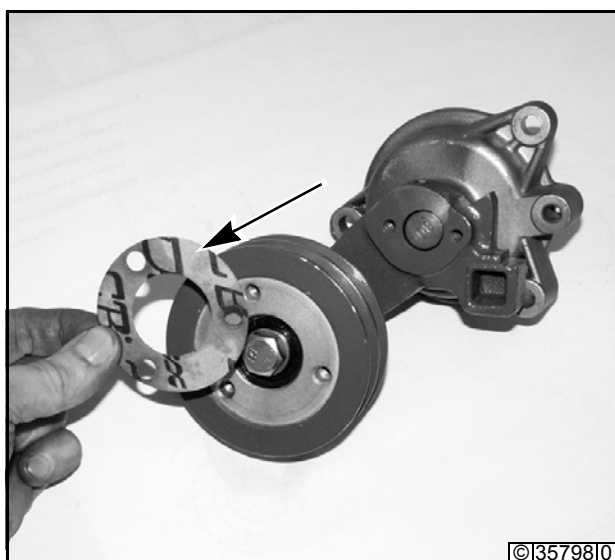
- Mount V-belt pulley, use circlips if necessary.



**Note**

Use the same number and thickness of circlips as with disassembly.

- Tighten hex nut.



- Place on new seal.



- Mount cover. Tighten bolts.



- Install V-belt idler pulley  
- see work card **W 12-1-4**.



## Removing and remounting the flywheel

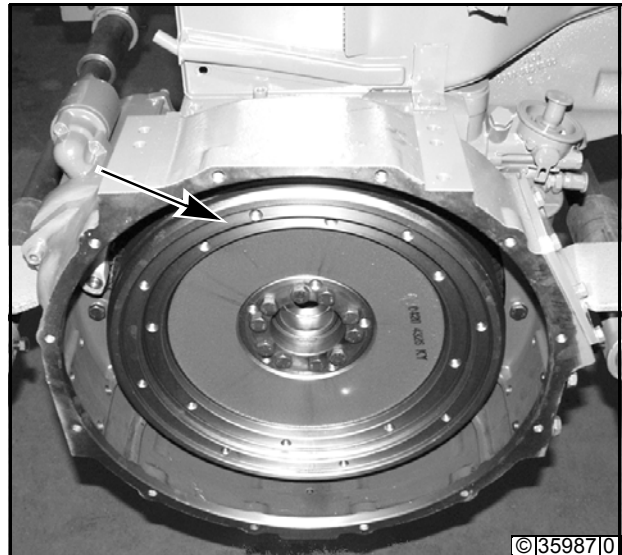


### Tools

- Commercial tools
- Special tools
- Guide mandrel (self-made)
- Retainer \_\_\_\_\_ 143 400

### Dismount flywheel

- Hold flywheel against V-belt pulley with retainer and dismount.



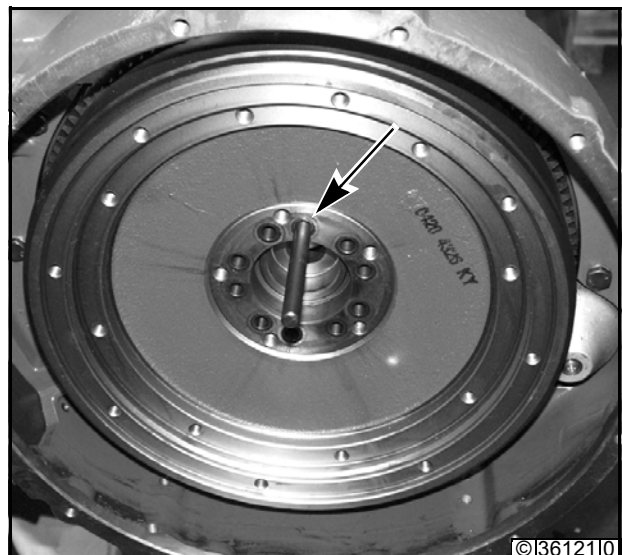
### Mount flywheel

- Position flywheel using a self-made guide mandrel.



### Note

Pay attention to centering sleeve.







- Tighten flywheel using **new** bolts.



**Renew starter ring gear on flywheel****Tools**

- Commercial tools

**References**

- W 12-6-1

**Dismount starter ring gear**

- Dismount flywheel  
- see work card **W 12-6-1**.
- Drill ring gear apart.

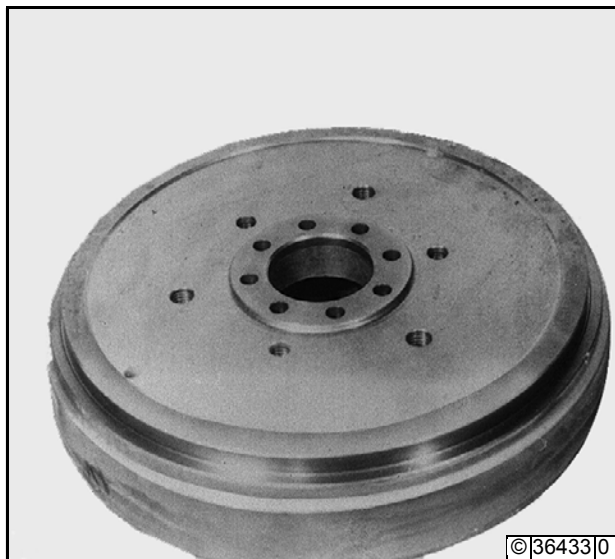
**Note**

Do not damage flywheel.

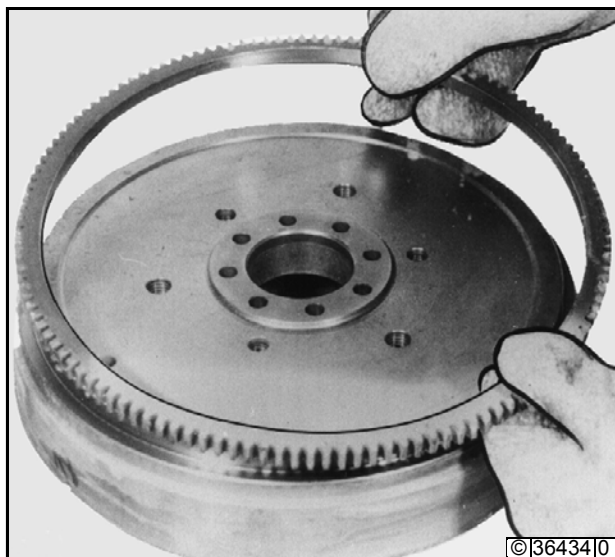


- Remove starter ring gear with a suitable tool.





- Clean flywheel and visually inspect at supporting flange.



#### Renew starter ring gear

- Heat up new ring gear to max. **210° C**. Place ring gear in position and bring to stop at flange.



#### Note

Chamfered teeth point away from flywheel.



- Mount flywheel  
- see work card **W 12-6-1**.

**Removing and remounting the three-phase alternator and support****Tools**

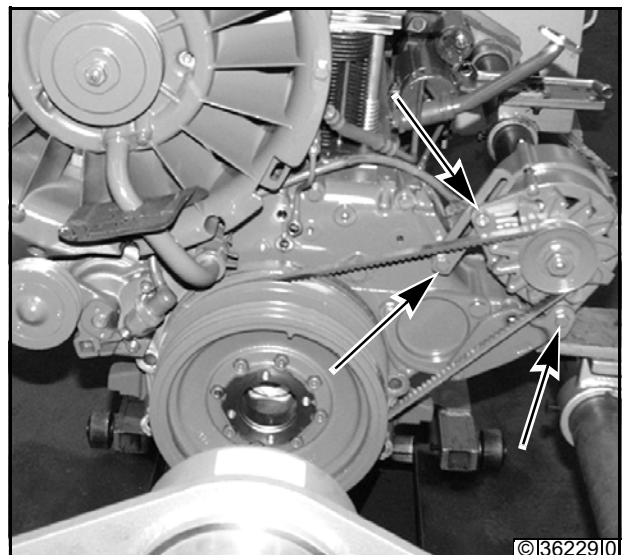
- Commercial tools
- V-belt tension gauge \_\_\_\_\_ 8115

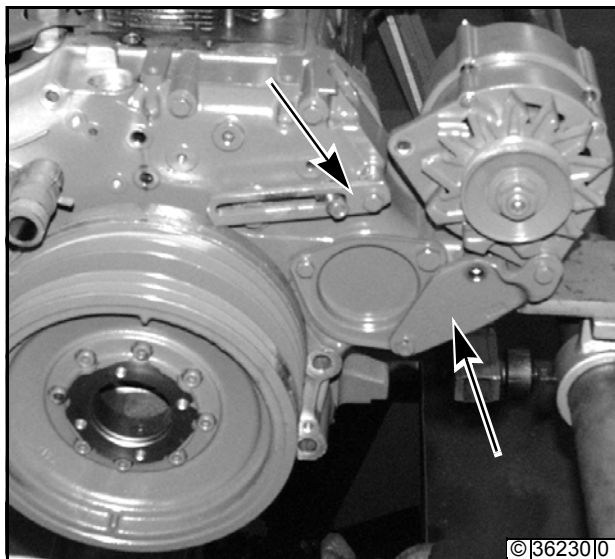
**Remove three-phase alternator and support**

- Tension idler pulley with a suitable tool and remove V-belt.

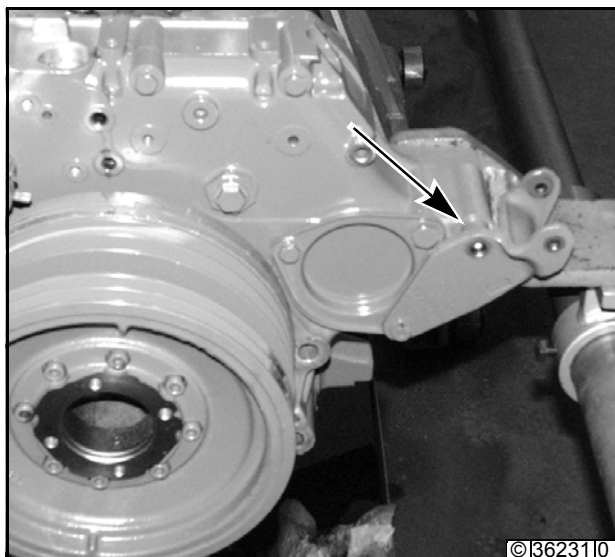


- Undo bolts of support and clamping plate.
- Swivel three-phase alternator and remove V-belt.





- Remove three-phase alternator, support and clamping plate.



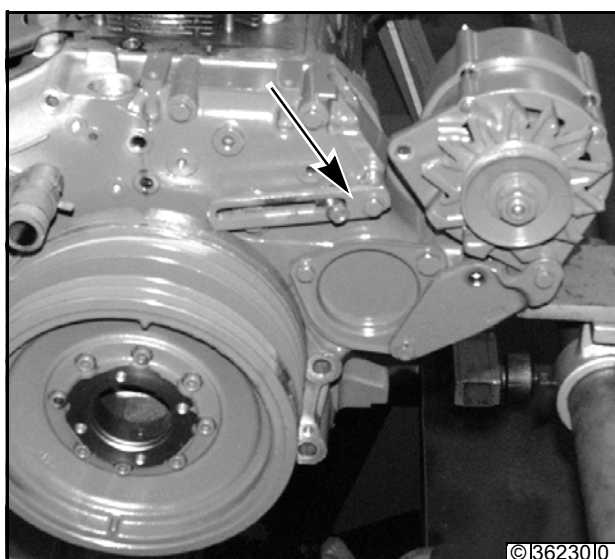
**Mount three-phase alternator and support**

- Mount support, bush and shim. Tighten bolt M 8.



**Note**

Use the same type of bushes and shims as disassembled.



- Mount clamping plate.
- Mount three-phase alternator and fasten the bolts fingertight.

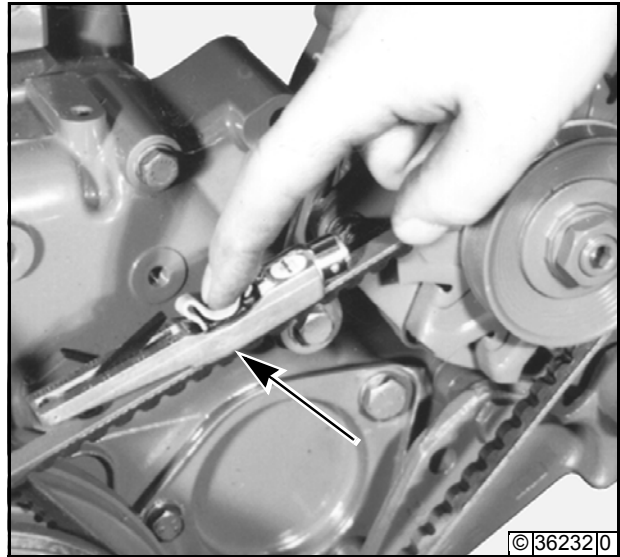


**Note**

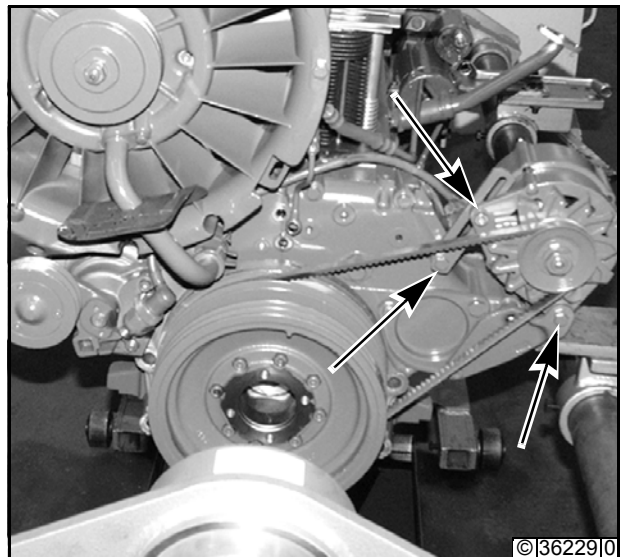
Use the same type of bushes and shims as disassembled.



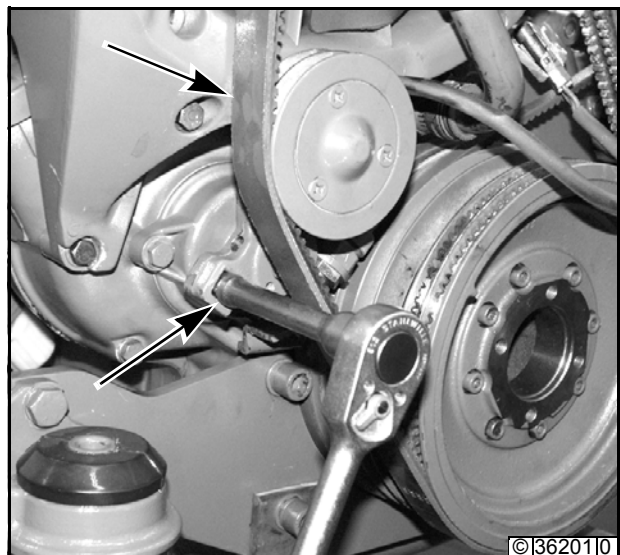
- Position V-belt and tension.
- Check tension with V-belt tension gauge.



- Tighten bolts of clamping plate and alternator.



- Tension idler pulley with a suitable tool. Place on V-belt.





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## Removing and remounting the starter

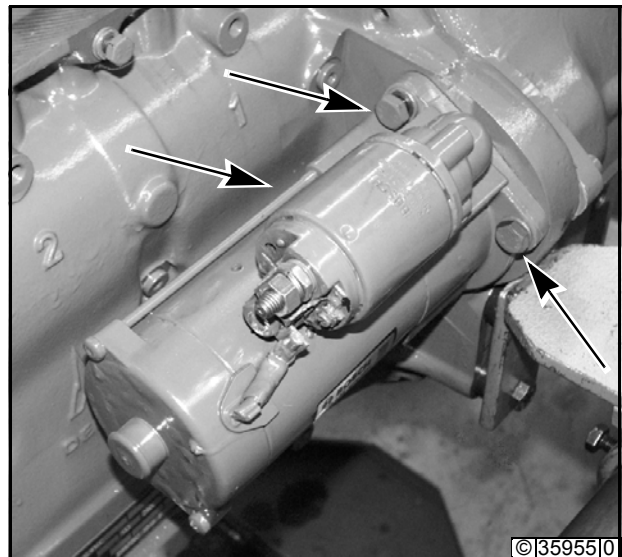


### Tools

- Commercial tools

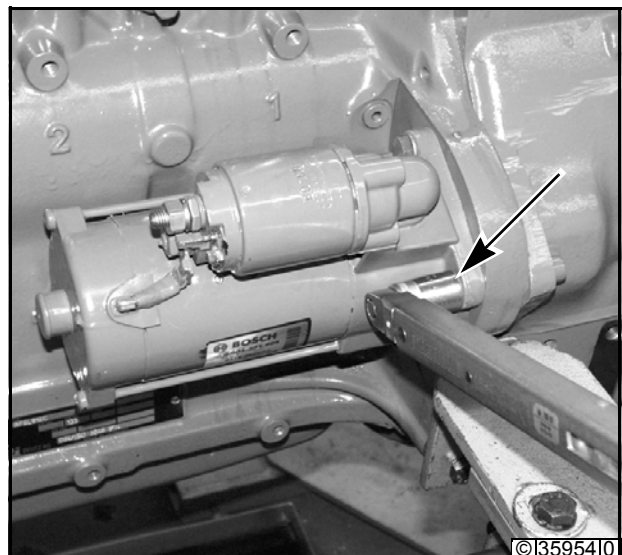
### Remove starter

- Take out bolts and remove starter.



### Remount starter.

- Tighten bolts.



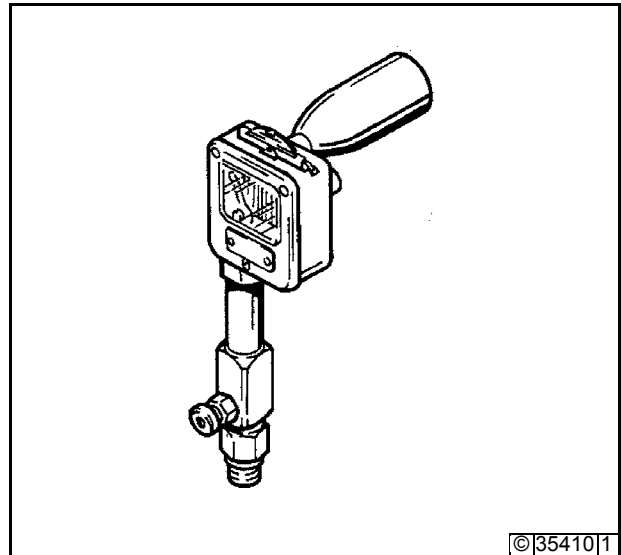
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Please order all your special tools direct from

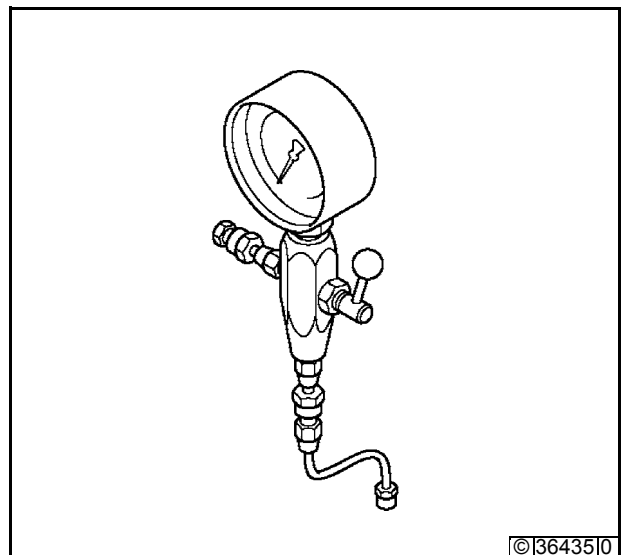
Wilbär GmbH & Co. KG,  
D-42826 Remscheid,  
Postfach 14 05 80,  
Fax 02191 / 8 10 92.

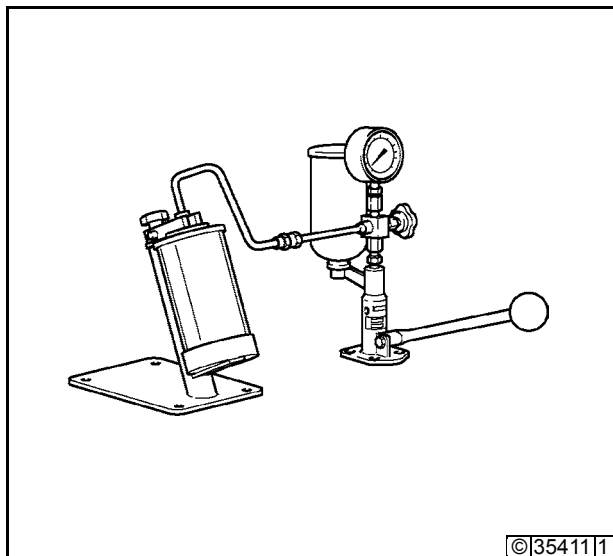
**Compression pressure tester**

Checking compression

**8005****Injection pump tester**

Pressure testing the injection pump

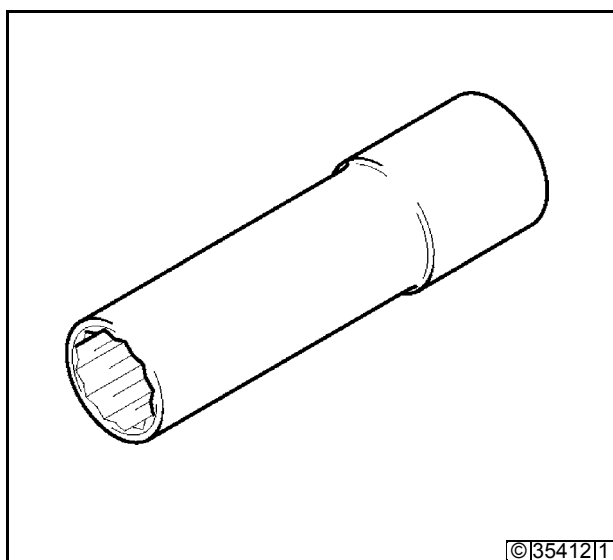
**8006**



**Nozzle tester**

Checking the injection nozzles

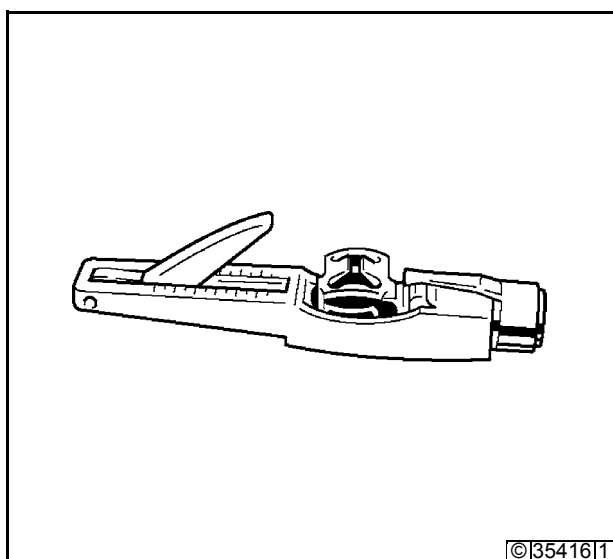
**8008**



**Long socket (15 across flats)**

Dismantling injection nozzles

**8012**



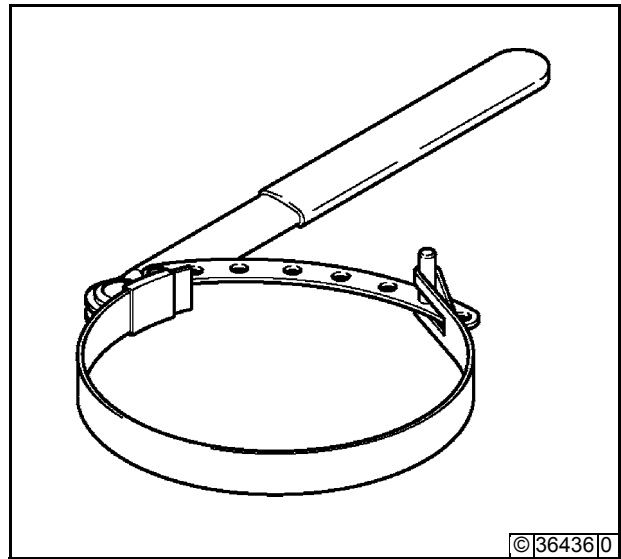
**V-belt tension gauge**

Checking tension of V-belt

**8115**

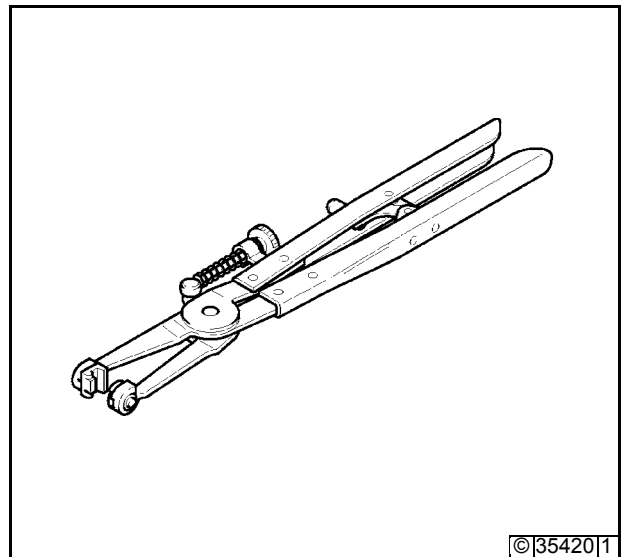
**Strap retainer for oil filter**  
Undoing oil filters

**8119**



**Spring-loaded clamp pliers**  
Gripping spring clips

**9090**





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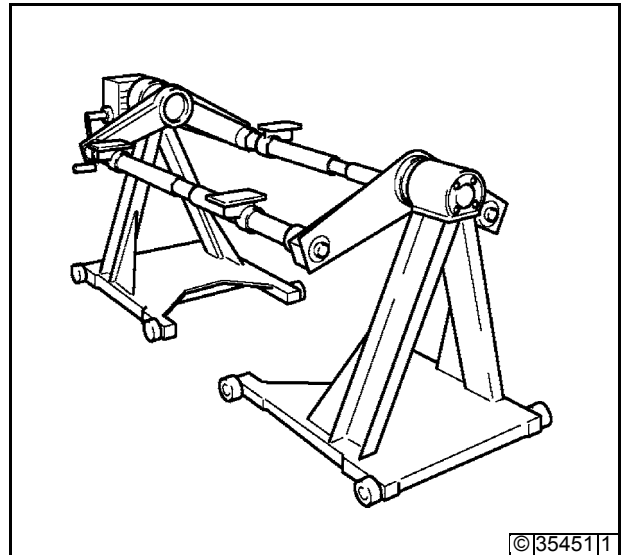
Please order all your special tools direct from

Wilbär GmbH & Co. KG,  
D-42826 Remscheid,  
Postfach 14 05 80,  
Fax 02191 / 8 10 92.

### Assembly stand

Clamping down engines on both sides

6066



©3545111

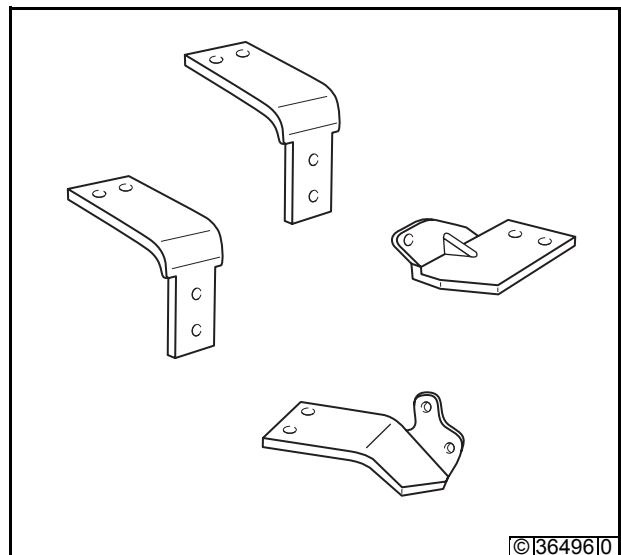
### Angled clamping plates

Set for double-sided chucking

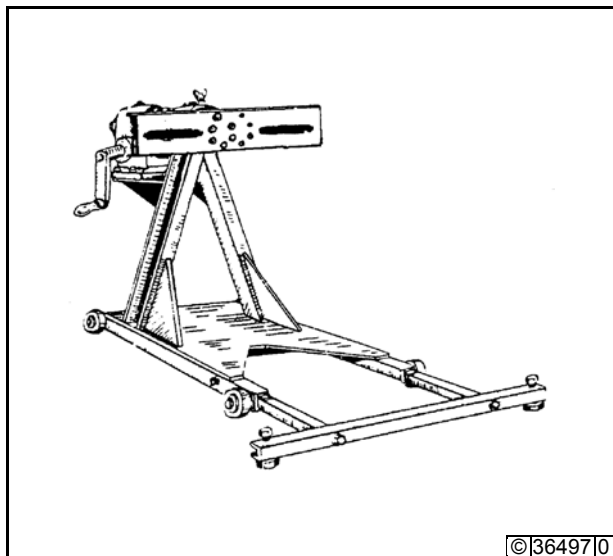
6066/154

consists of:

- |                          |          |
|--------------------------|----------|
| 2 angled clamping plates | 6066/154 |
| 1 angled clamping plate  | 6066/155 |
| 1 angled clamping plate  | 6066/156 |



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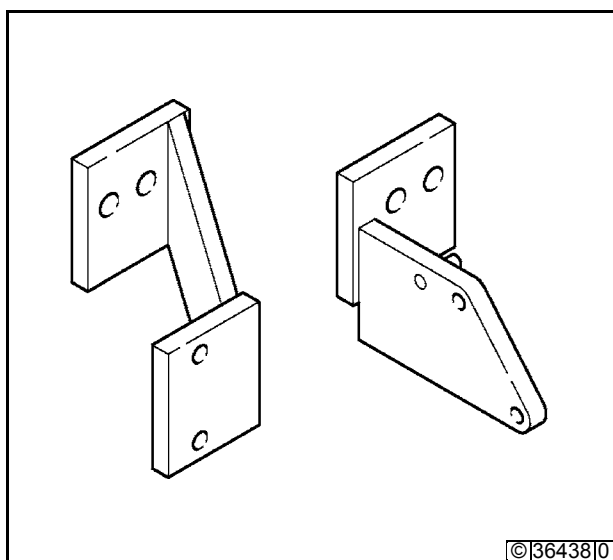


**Engine assembly stand**

**6067**

For clamping down engine on only one side

© 36497 | 0

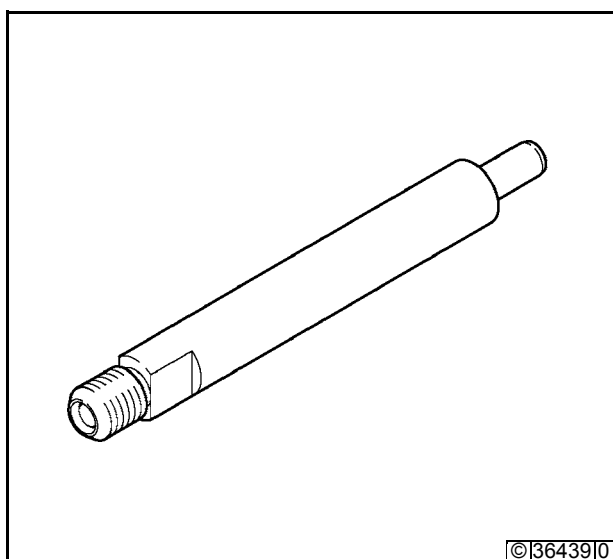


**Angled clamping plates**

**6067/112**

Set for one-sided clamping

© 36438 | 0



**Connector**

**100 140**

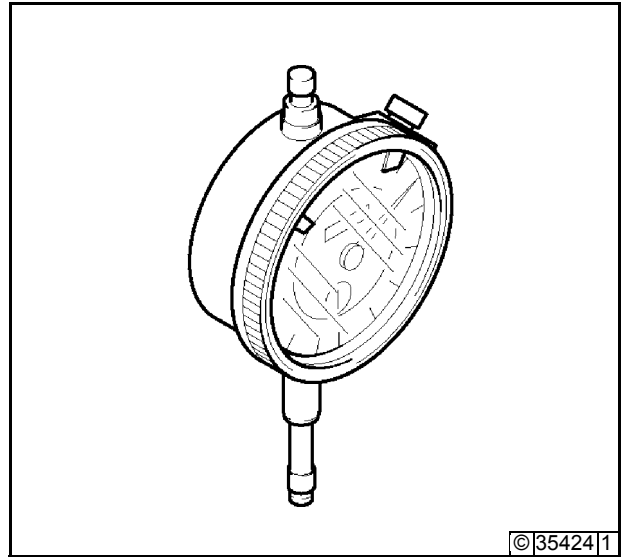
Check compression

© 36439 | 0

**Dial gauge (0,01 mm)**

**100 400**

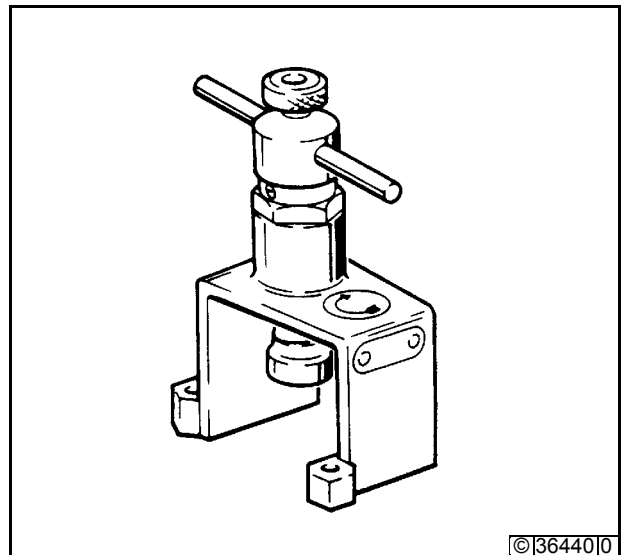
Checking and adjusting top dead centre  
Checking and adjusting exhaust thermostat  
Measuring idler gear bearing  
Checking camshaft bearings  
Measuring cylinders  
Measuring crankshaft  
Measuring connecting rod  
Measuring cylinder head components



**Adjusting device**

**100 640**

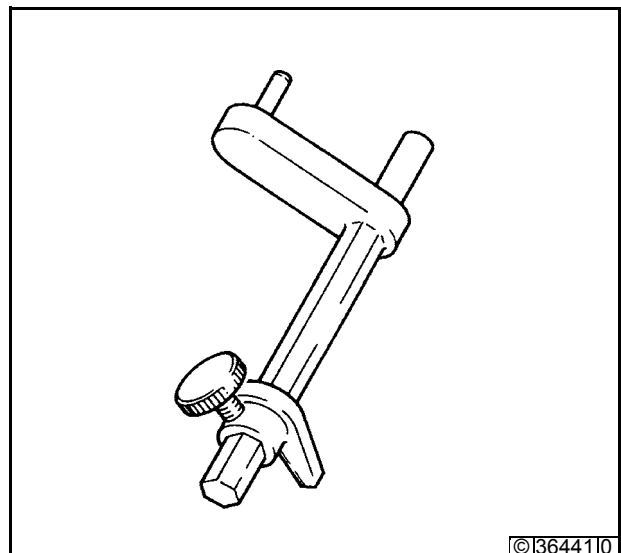
Determine top dead centre (TDC) using  
dial gauge 100 400

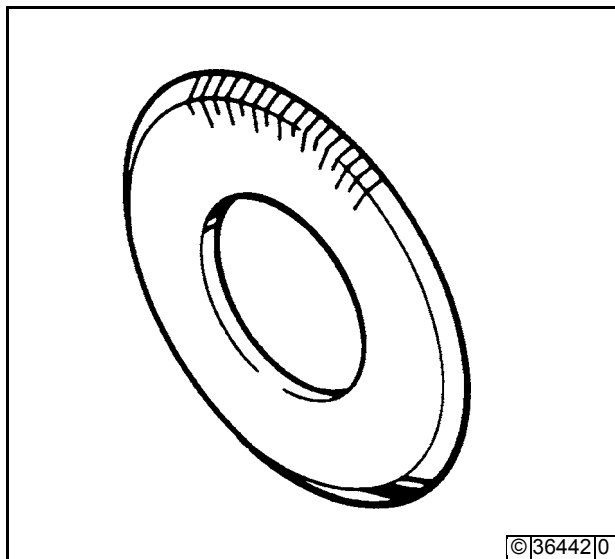


**Pointer for TDC marking**

**100 740**

Determine top dead center (OT)



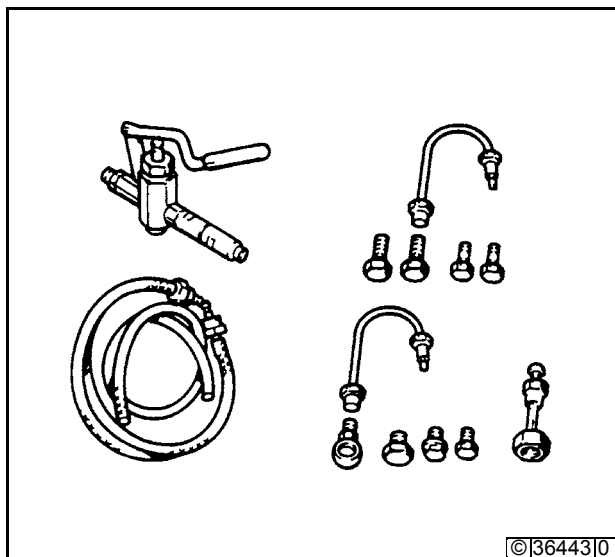


**Graduated disc, magnetic**

**100 910**

For checking fuel delivery timing, used on freely accessible V-belt pulleys

© 36442 0

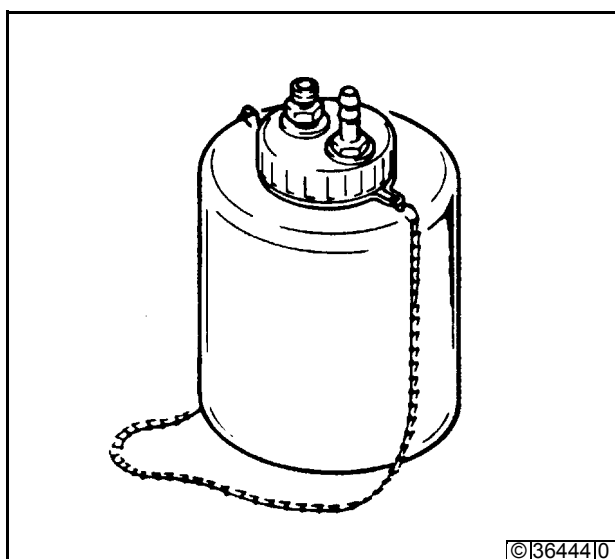


**High-pressure hand feed pump**

**101 500**

For checking and adjusting static commencement of delivery

© 36443 0



**Reservoir tank**

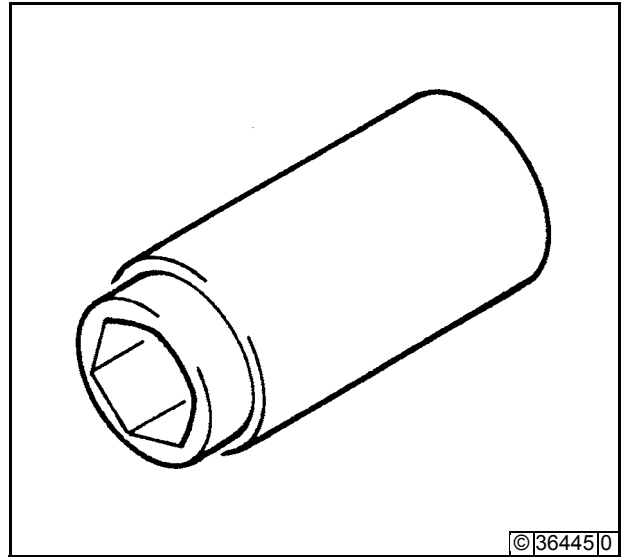
**101 510**

Receptacle for high-pressure hand feed pump

© 36444 0

**Socket wrench (width across flats 24) 101 600**

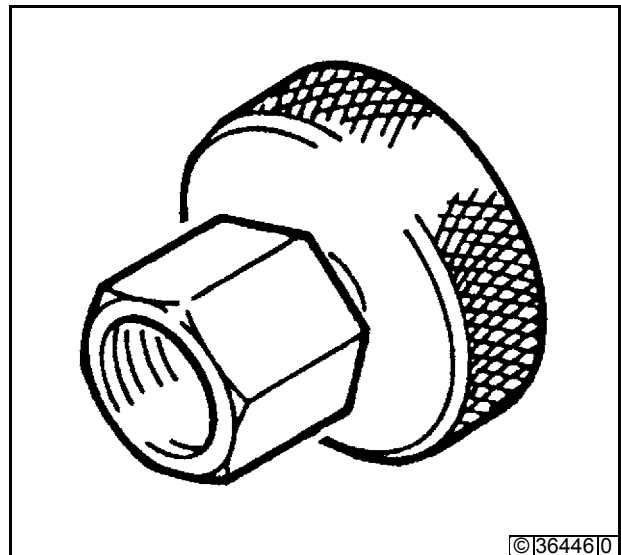
Disassembling and fastening expansion pin housing,  
exhaust thermostat



**Dial gauge holder 101 610**

**101 610**

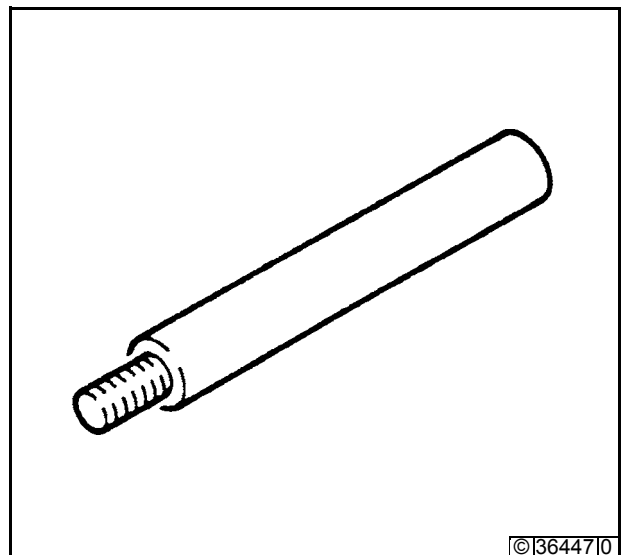
Checking and adjusting exhaust thermostat



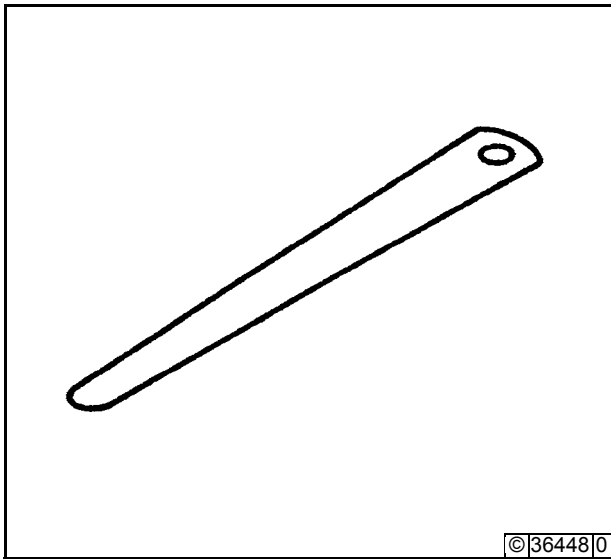
**Extension pin for dial gauge**

**101 620**

Checking and adjusting exhaust thermostat





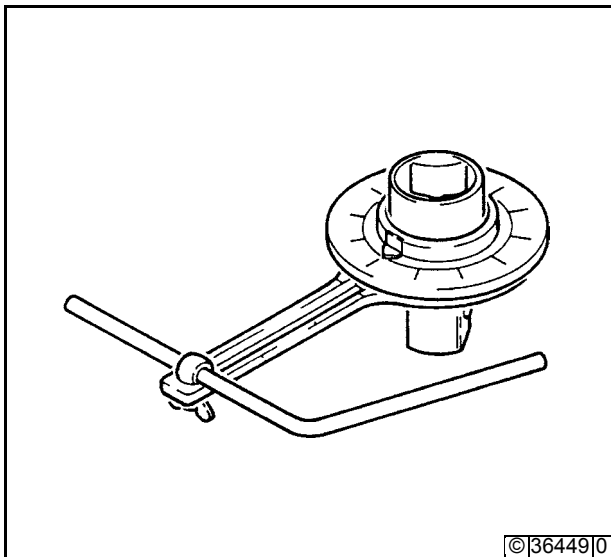


**Feeler gauge 0.2 x 3.0 mm**

**101 630**

Checking and adjusting valve clearance

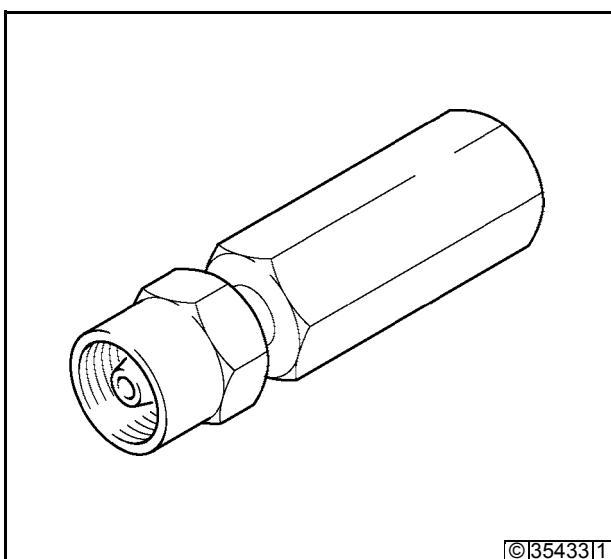
Checking and adjusting exhaust thermostat



**Tightening angle dial indicator**

**101 910**

Tightening angle dial indicator for mainbearing,  
big-end and flywheel bolts, etc.



**Extractor**

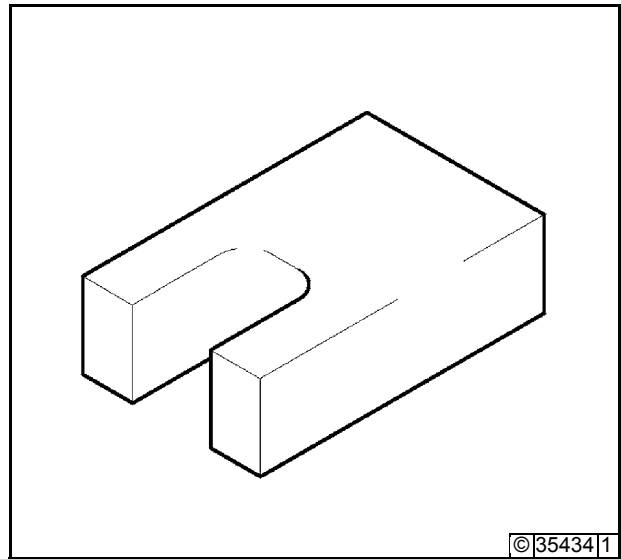
**110 030**

Extractor for injectors, to be used with 150 800

**Dolly**

Injector, a/flats 11

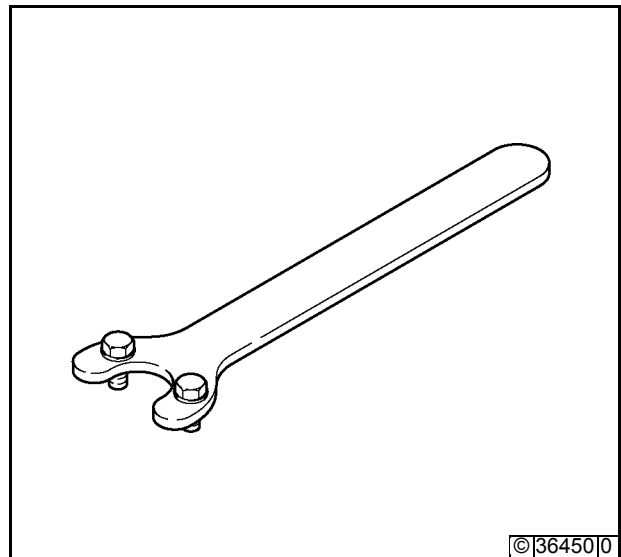
**110 110**



**Retainer**

Hub on injection pump

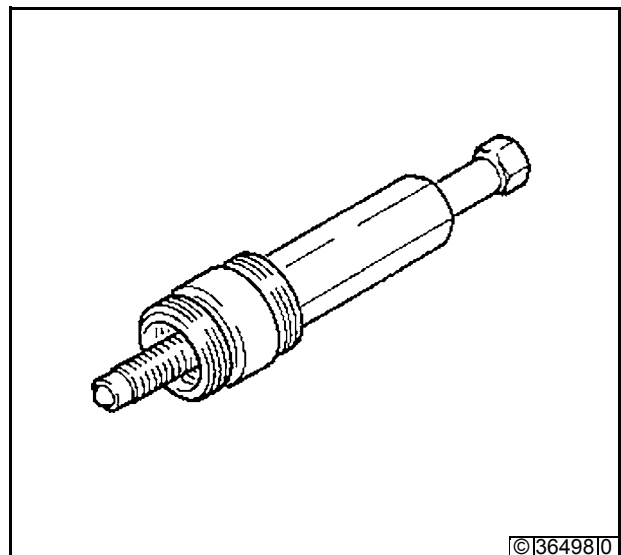
**110 190**

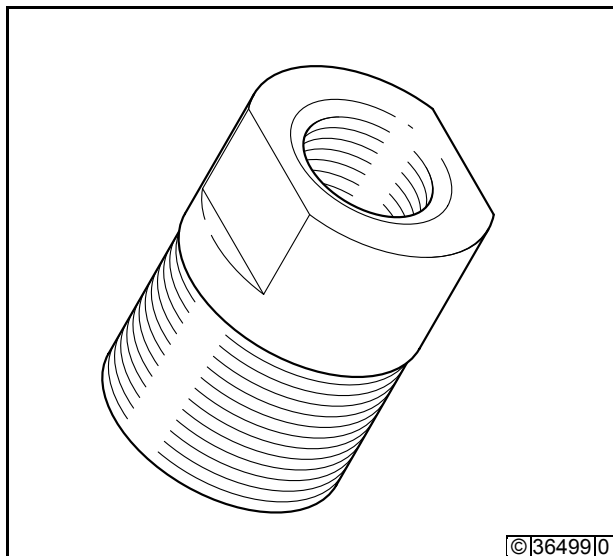


**All-purpose device**

Pressing down injection timing mechanism/drive wheel

**110 340**



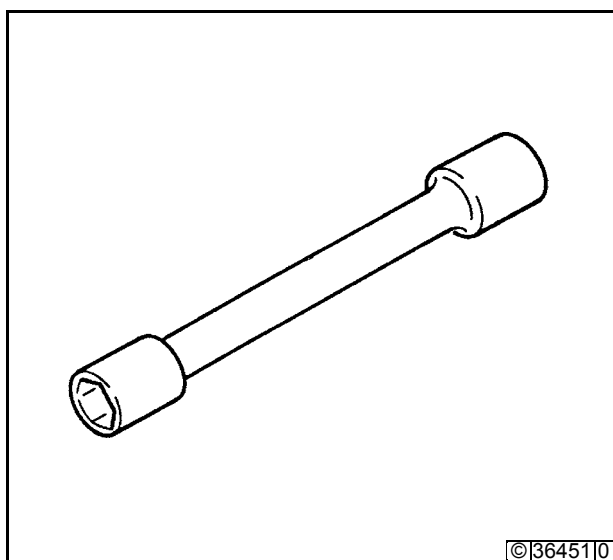


**Extra sleeve**

**110 410**

Dismounting injection timing mechanism for  
Motorpal injection pump with 30 mm conical shank

© 36499 | 0

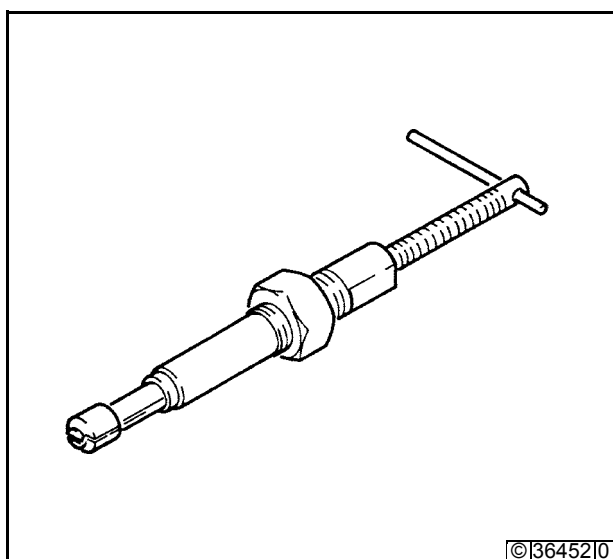


**Cylinder head wrench**

**120 040**

Undo and tighten cylinder head bolts

© 36451 | 0



**Extracting device**

**120 630**

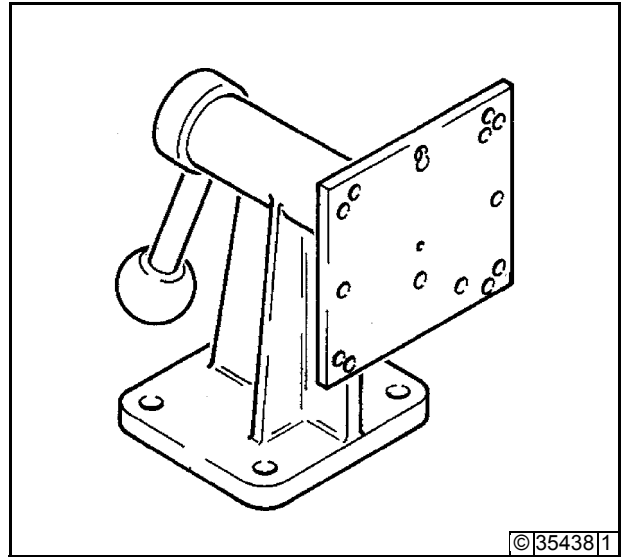
Injector sealing ring

© 36452 | 0

**Swivel-type clamping stand**

**120 900**

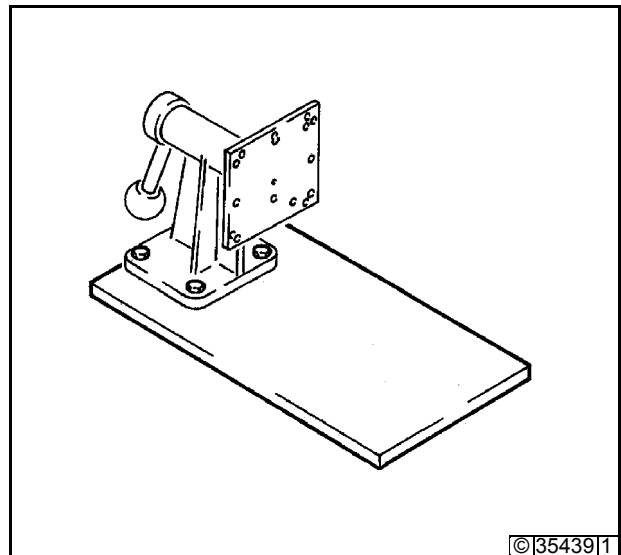
Assembly/disassembly of cylinder head



**Clamping plate**

**120 910**

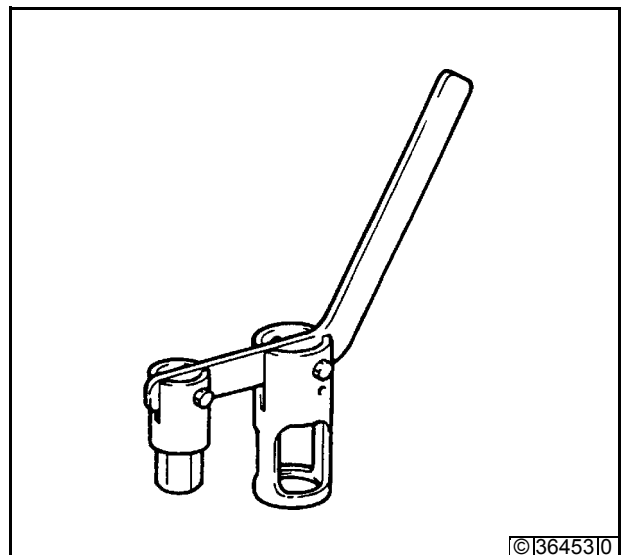
Clamping plate for cylinder head with 120 900

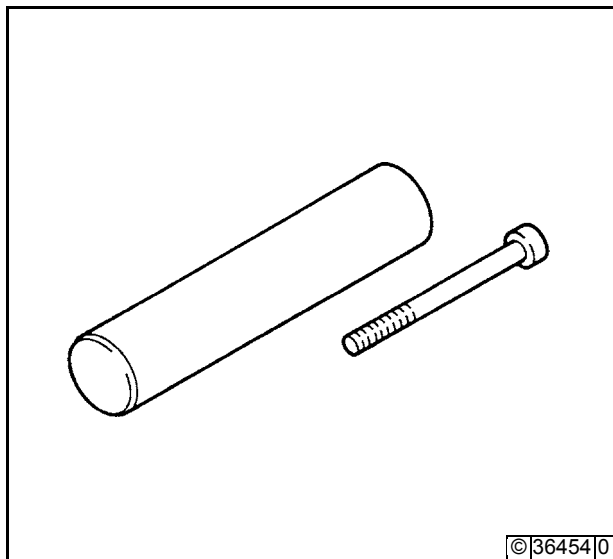


**Valve spring compressor**

**121 120**

Compressing valve springs

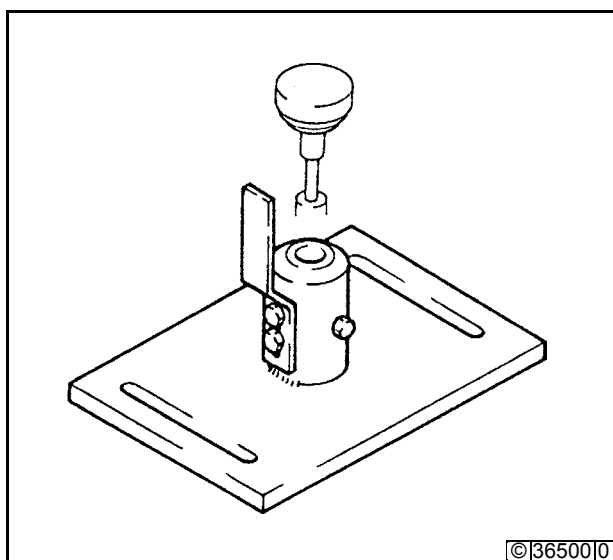




**Clamping arbor**

**122 450**

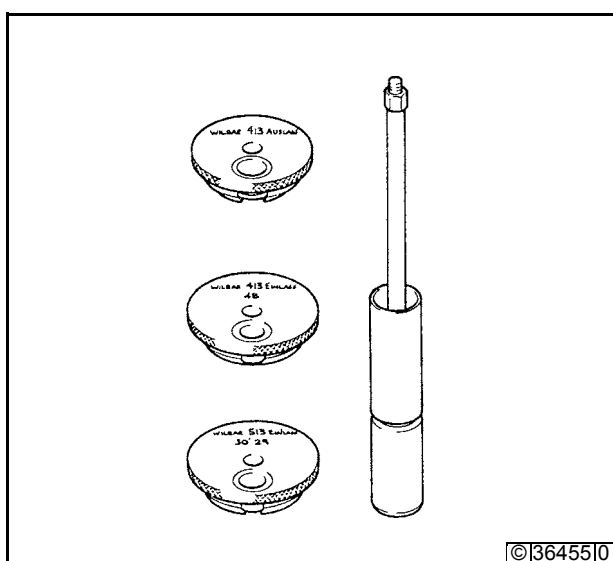
Cutting valve seat inserts on lathe



**Drill jig (basic unit)**

**122 460**

Milling out valve seat inserts down to base



**Pilot pins with drill jig bushes**

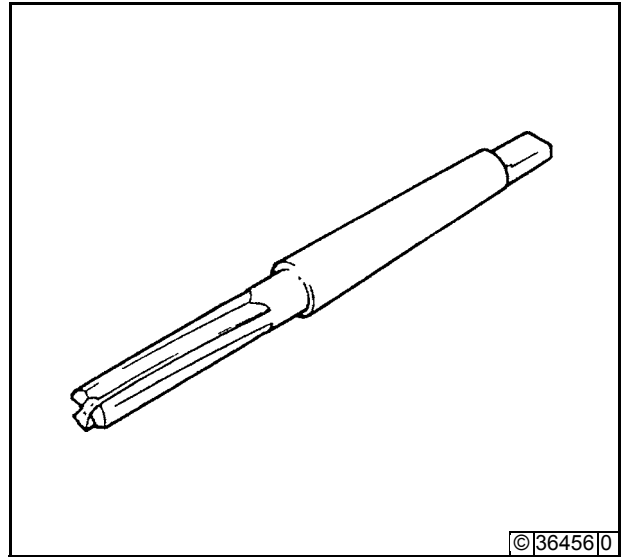
**122 461**

Milling out valve seat inserts down to base

**Hard metal special milling cutter**

**122 463**

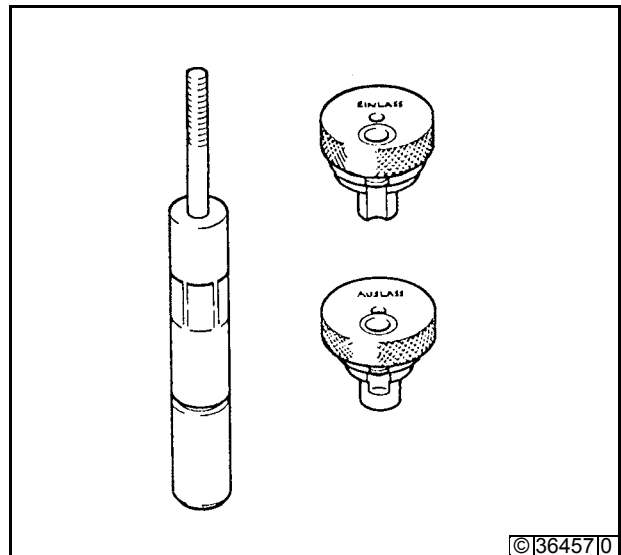
Milling out valve seat inserts down to base



**Pilot pins**

**122 464**

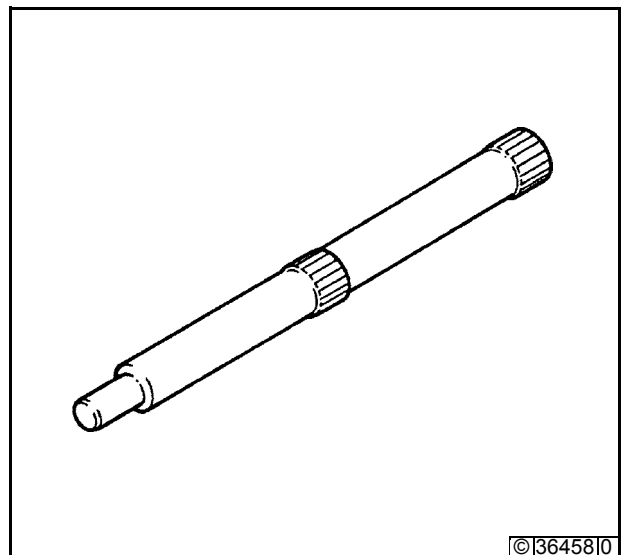
Remachining cylinder heads on a lathe



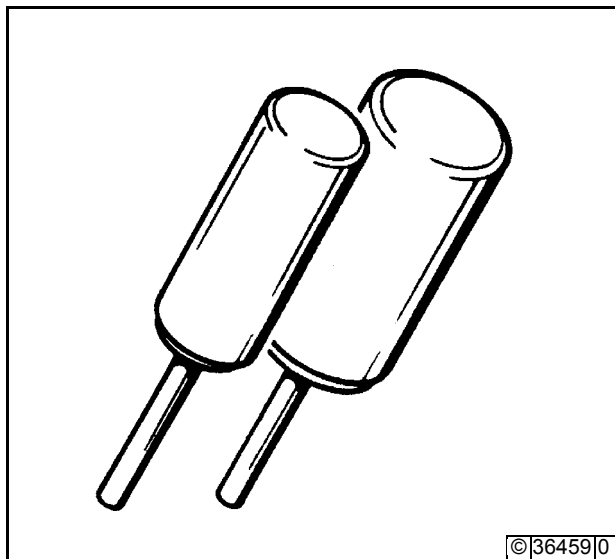
**Assembly mandrel**

**123 310**

Valve guides





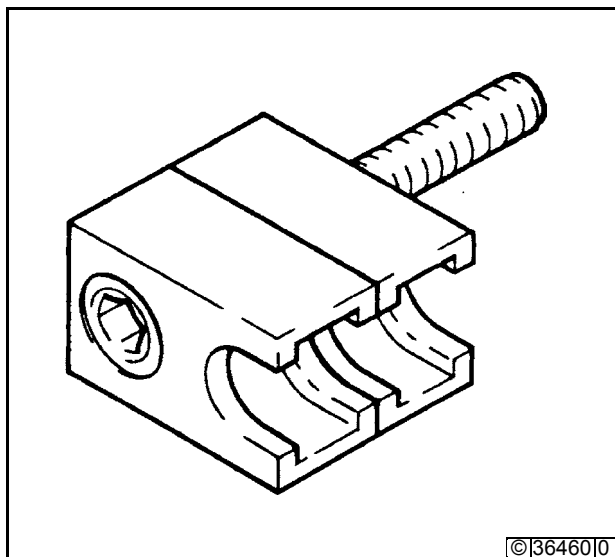


**Assembly mandrels**

**123 950/960**

Valve seat inserts exhaust valve 123 950

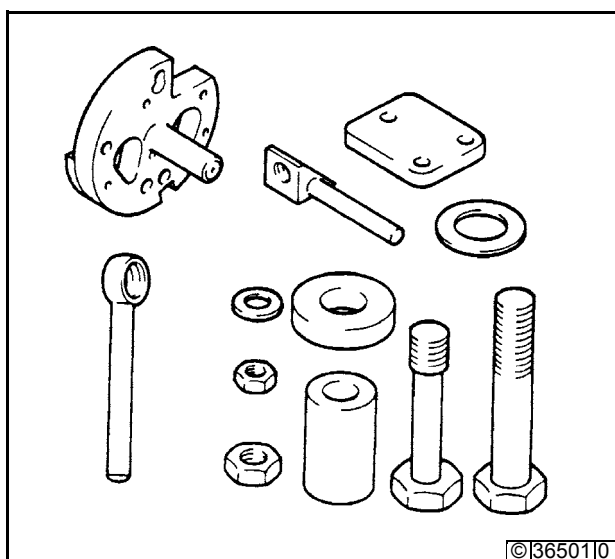
Valve seat inserts inlet valve 123 960



**Spring compressor**

**125 310**

Fitting pushrod cover tubes (in case of exhaust air heated systems 2 x 125 310)



**Clamping fixture**

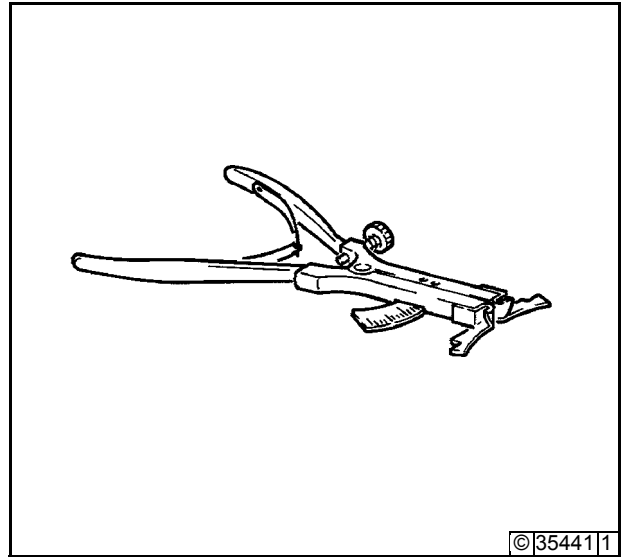
**125 500**

For cylinder heads, for remachining the seat face on a turning lathe

**Piston ring pliers**

Removing and fitting piston rings

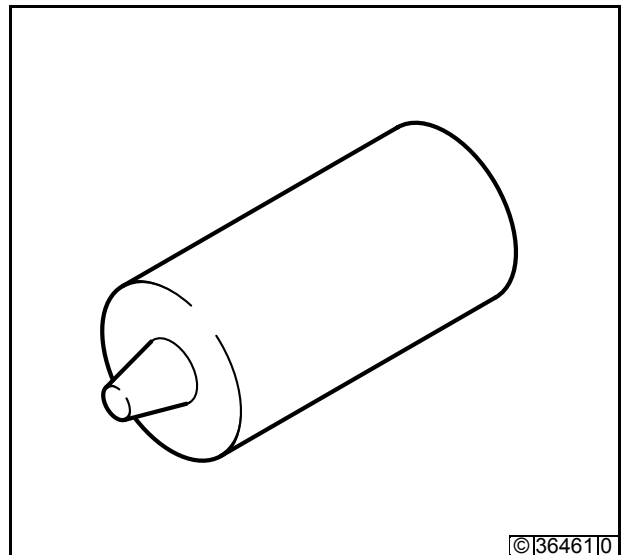
**130 300**



**Trapezoid groove wear gauge**

Checking piston ring grooves

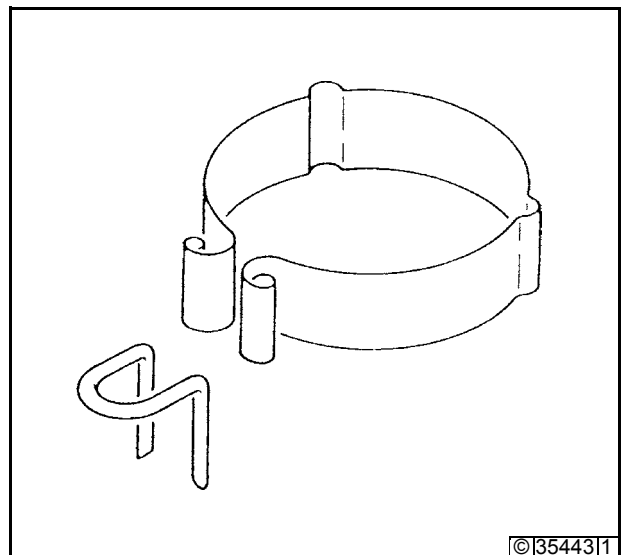
**130 360**

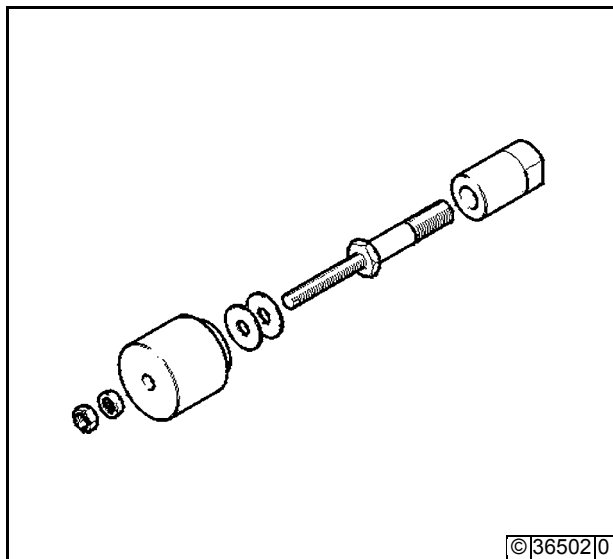


**Piston ring tensioning belt (Ø 102)**

Compressing piston rings on piston

**130 600**

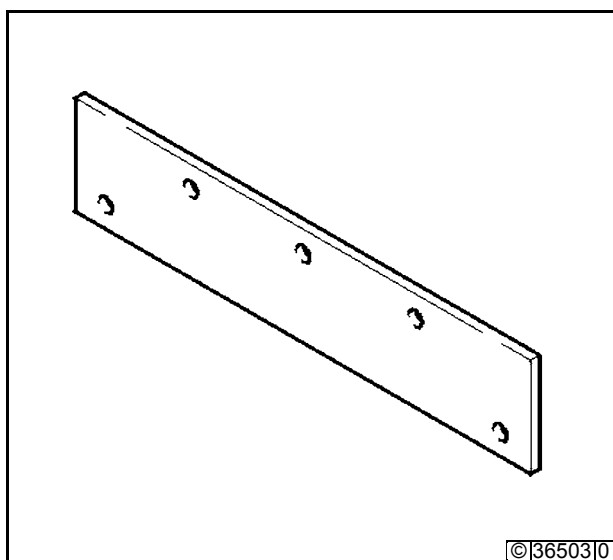




**Assembly device**

**142 060**

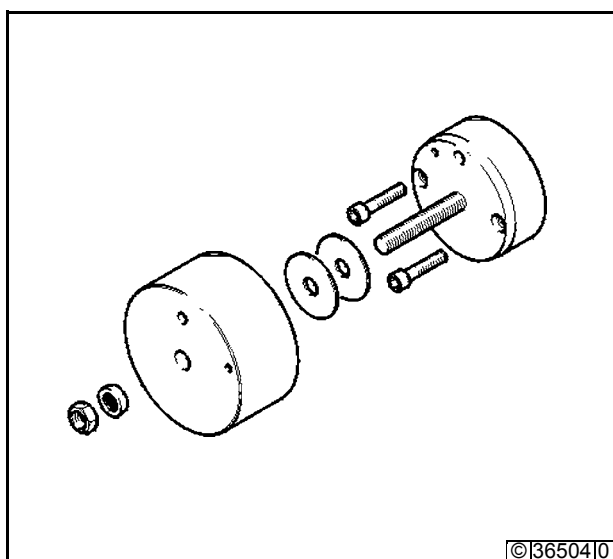
Pressing-in crankshaft seal (head end) for  
crankshaft seal



**Retainer plate**

**142 070**

to 142 080 for rear cover



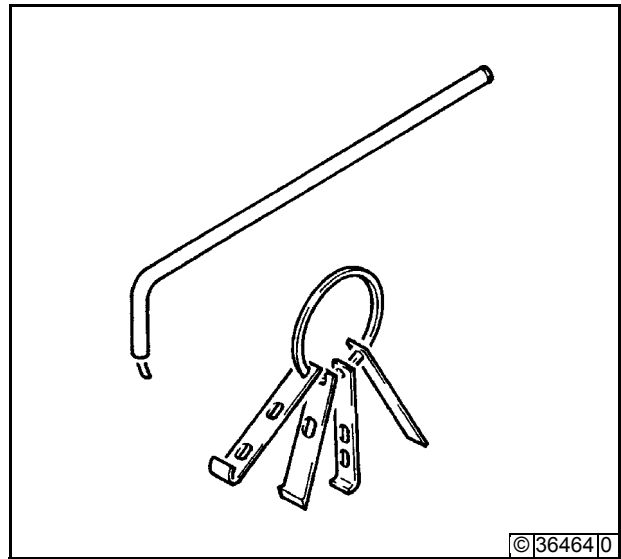
**Assembly device**

**142 080**

Pressing-in crankshaft seal (coupling end)

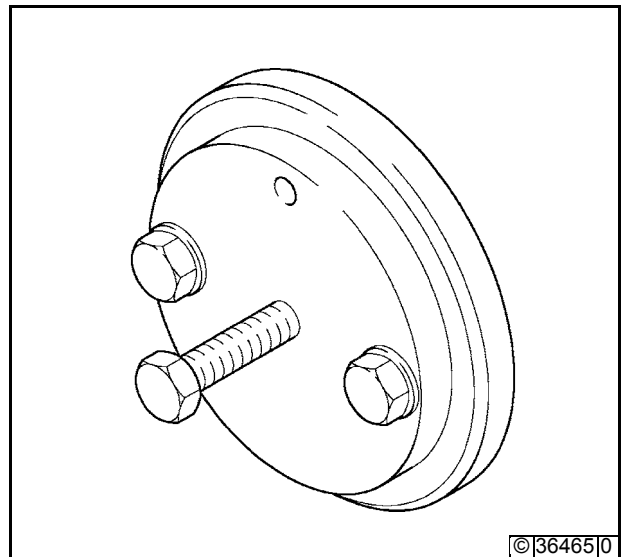
**Extracting device**  
Crankshaft seals

**142 700**



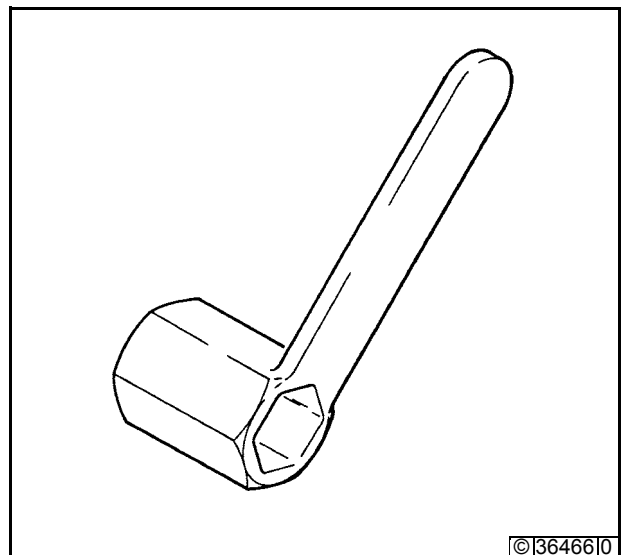
**Centering device**  
Rear cover

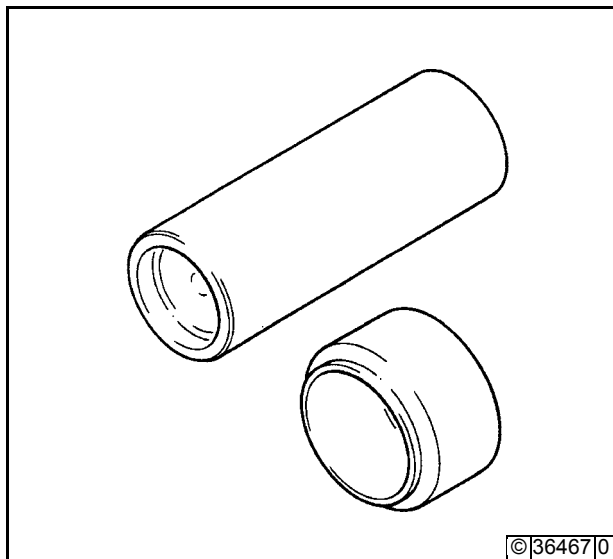
**143 110**



**Retainer**  
V-belt pulley

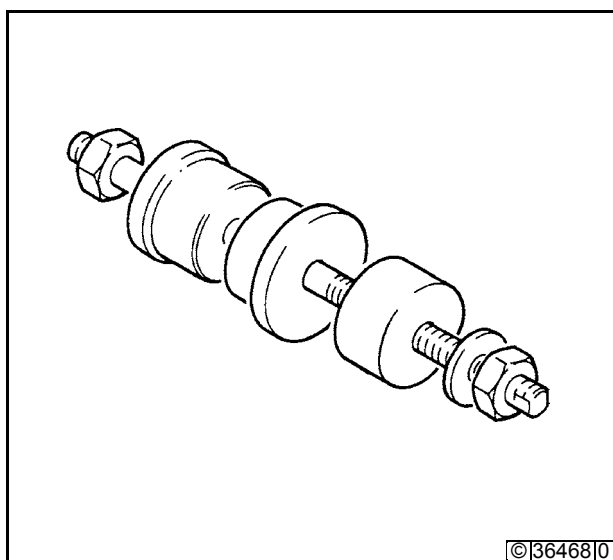
**143 400**





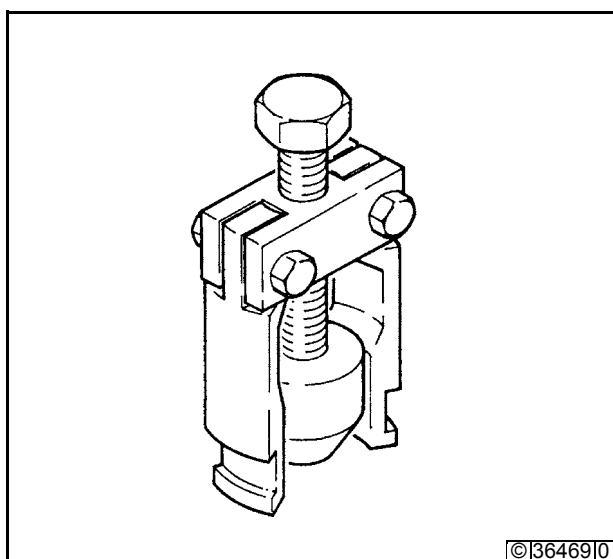
**Press-in device**  
Camshaft hole cover

**143 610**



**Assembly device**  
Camshaft bush

**143 630**



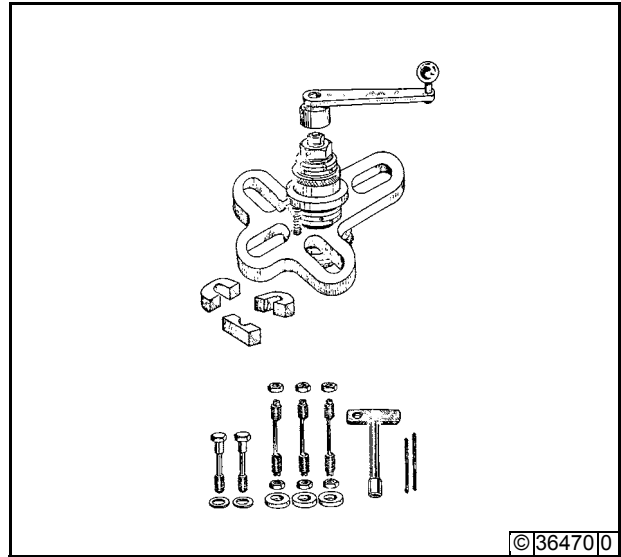
**Pull-off device**  
Gear on hydraulic pump

**144 750**

**Re-facing device**

Cylinder seat face on crankcase

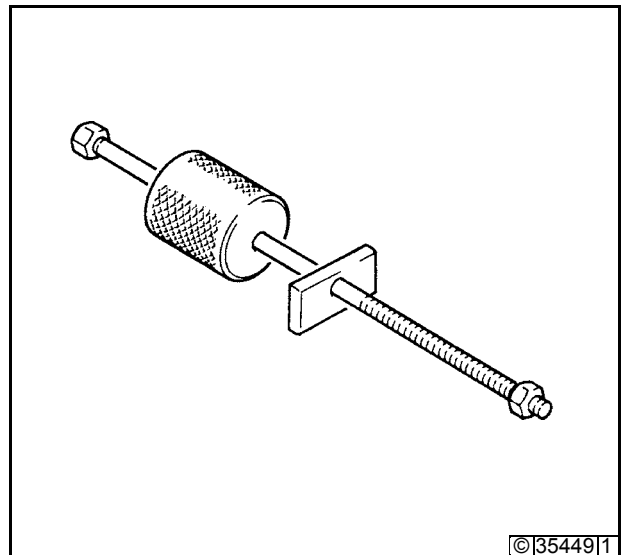
150 020



**Extractor**

Injectors

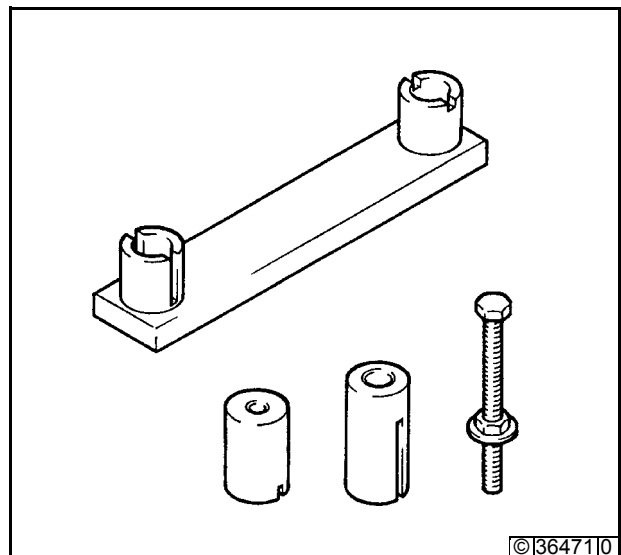
150 800



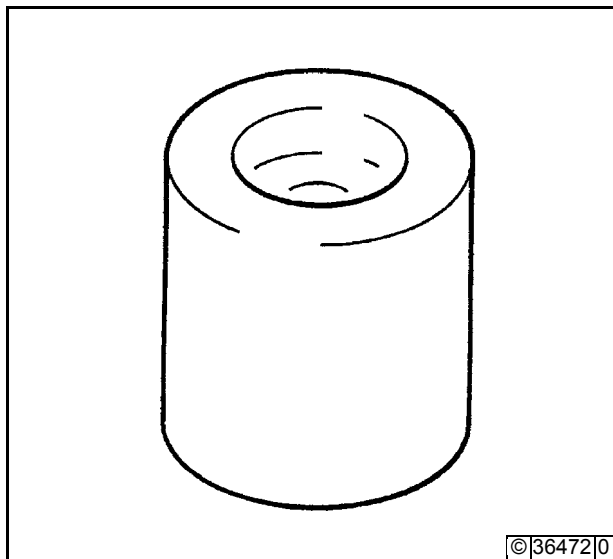
**Device for oil spray nozzles**

Nozzles for piston cooling

151 100



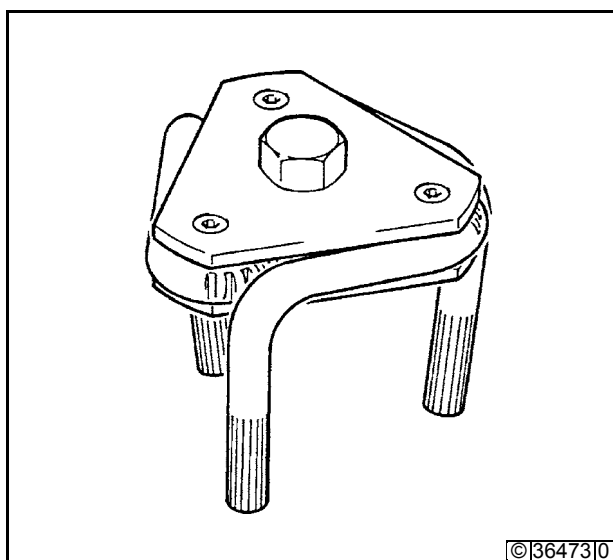




**Assembly arbor**

Shaft seal (Oil-controlled fan)

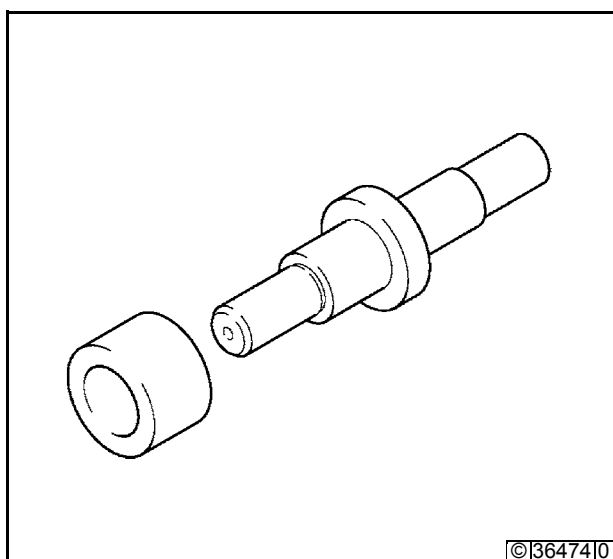
**160 260**



**Special device**

Screwing off filter cartridges

**170 050**



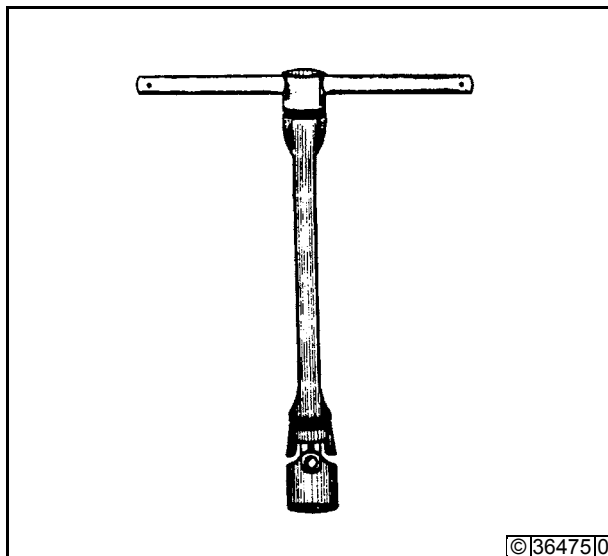
**Assembly arbor**

Bearing bushes shaft seal

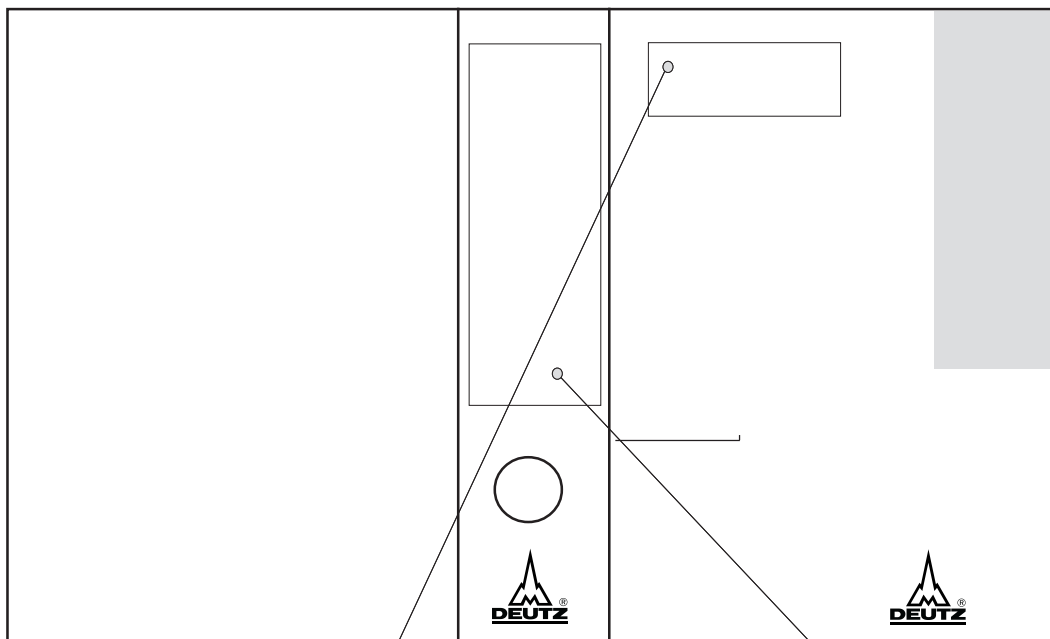
**170 130**

**Special universal joint wrench (1 item) 170 800**

Extension kit for intake manifold bolts



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